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[ISSUED MAY 27, 1901.]

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OF

The New York Botanical Garden

Vol. 2. No.

REPORT OF THE SECRETARY AND DIRECTOR-IN-CHIEF.

(*Submitted and accepted, January 14, 1901.*)

To the Board of Managers of the New York Botanical Garden.

Gentlemen: I have the honor to submit herewith my report as Secretary and Director-in-Chief for the year ending January 14, 1901:

Plants and Planting.

1. *Herbaceous Grounds.* No noteworthy changes in the installation of the herbaceous collection, located in the valley south of the museum building, have been made during the year; work on this plantation has been mainly restricted to maintaining the groups already planted and in adding to them species derived from exchanges, collecting, and grown from seeds in the nurseries. Many of the species planted during the three preceding years have now become well established and show their true character in a very satisfactory way. The increase in the number of species and in the size of clumps previously planted has necessitated taking more of the ground under cultivation in accordance with the general plan originally adopted. The total number of species grown in the herbaceous grounds during the year is about 2,300.

This collection is now the most completely installed and furnishes satisfactory illustration of 105 different natural families. It has been constantly used by students and by the public and has become an important educational feature, and this without in any way marring the natural beauty of the valley, while furnishing in color and in form a very attractive area of the Garden.

2. *Fruticetum.* The collection of shrubs, arranged in natural families on the plain northeast of the museum building, has been greatly increased in number of species, through plants drawn from the nurseries and other sources. A noteworthy addition to it was made in the autumn by the purchase from the Biltmore estate in North Carolina, of a large number of specimens representing species not hitherto in the collection. Here, as in the herbaceous grounds, it has been necessary to take considerable more land under cultivation to accommodate the newly-planted shrubs and to give sufficient space to those previously planted, the design being to permit each individual shrub to assume its natural form and character in so far as conditions will permit. The collection now contains about 450 species, being a gain of about 110 species over the record for 1899, and is sufficiently developed to well represent the natural families containing shrubs hardy in this latitude; it has also been considerably used by students.

3. *Salicetum.* The development of the collection of willows in the marshy grounds north of the fruticetum and near the northern end of the Garden has been continued by the planting of additional species moved from the nurseries; sufficient time has not yet elapsed for these shrubs and trees to attain their true character, but the collection is in good order, though not yet conspicuous; about 40 species are represented there.

4. *Arboretum.* The planting of trees in the region east of the Bronx River in accordance with the general plan has been continued, the number of deciduous species now represented in this collection being 150; this number added to the 50 species native to the grounds, and to the pines, yews

and other conifers planted in the pinetum south of the museum shows that about 220 kinds of trees are now represented in the Garden exclusive of those still in the nurseries. The Arboretum planting will necessarily be inconspicuous for a number of years, owing to the length of time required for the growth of trees into their true form and character.

5. *Viticetum.* The collection of vines and climbers installed on an arbor east of the museum has been increased in number of species from 45 to 60 during the year. Some of the specimens have now attained sufficient growth to be characteristic.

6. *Nurseries.* The building of the propagating houses during the fall and the desirability of concentrating the nursery work in their immediate vicinity gave reason for the abandonment of the first nursery planted in 1895, and the moving from it of the plants desirable for preservation to various parts of the grounds; this work was partially accomplished in the autumn and may be completed in the spring. The present design is to return to the provisions of the general plan, which was adopted subsequent to the planting of this first nursery, and to bring all the nursery work together in the region immediately south of the propagating houses and along the east boundary of the Garden, where the other nurseries were planted in 1897 and 1898. This change has made it desirable to take some additional land under cultivation; the new arrangement will facilitate work on these plantations.

7. *Boundary Borders.* The screens around the borders of the Park have been considerably developed during the year by additional planting and substitution. The stretch from the Southern Boulevard to St. John's College grounds along the railway has been planted for the first time, and considerable planting has been done along the line of St. John's College property, from the railroad east to the Southern Boulevard, although no completion of this border screen can well be made until next year, after the traffic road which replaces the present Southern Boulevard is built; this very desirable substitution will be effected during the next season

under a contract awarded by the Commissioner of Parks to John B. Devlin on January 3, 1901. The screen along the north border of the grounds has also been strengthened by additional planting, but it has not as yet been desirable to develop the eastern boundary border to any considerable extent, nor is it likely to be in advance of the building of the boulevard, planned by the department of Public Works to bound the Park on its eastern side from West Farms to Williamsbridge, owing to the necessary modifications of the surface along this line required by the building of this road. It is desirable from the standpoint of improving the eastern side of the Park, that this boulevard should be built at as early a time as is practicable. I have had some consultation with officials of the Department of Public Works relative to this matter, but nothing tangible has yet been developed.

8. *Temporary Greenhouse.* The plants growing for several years in the greenhouse of Columbia University on Morningside Heights were moved into the new main conservatories during the summer and furnished an important nucleus for the collections in those buildings; the decision of the University Trustees to demolish the old greenhouse made it possible for us to obtain from them a considerable number of plants additional to those actually grown by us. The use of this old greenhouse has been an important adjunct in our work of preparation and I have expressed to the President of the University our appreciation of the permission to use it.

9. *The Main Conservatories.* The eight houses of this range built under the contract of the Department of Parks with John R. Sheehan were completed in June and the buildings turned over to us by the Department for operation. In addition to the plants derived from the Columbia University greenhouse, a number of specimens obtained by gift and exchange sufficient to effect a preliminary installation of the collections have been reported in the successive numbers of our Journal; it is most gratifying to know that the whole collection has been brought together without the actual purchase of more than $100 worth of specimens. The number of species contained in the collec-

tion at the present time is about 1,800 and the number of individual specimens, nearly all of which are now in tubs or potted, is 8,833. Naturally a great many duplicates have been received and grown from seed, some of which have been used in exchanges and some have been given away to visitors. The arrangement of the specimens has been made as nearly as practicable, under the conditions of temperature and humidity into natural familes; the central dome (House No. 1), the house just east of it (No. 13) and the three houses to the west of it (Nos. 2, 3, 4) are at present operated as tropical houses under slightly different temperatures; the two eastern houses (Nos. 11, 12) are operated as temperate houses, while the house forming part of the west wing of the range (No. 5) is operated as a succulent house. House number 1 contains the palms and the cycads; house number 2 contains the smaller tropical ferns, tropical orchids and pitcher plants; house number 3, contains the begonias, the bromeliads, the amaryllis family and a number of smaller families; house number 4 contains the large plants of the lily family such as dracaenas and yuccas, the screw-pines, the bananas and their relatives, the tree-ferns, the aroids, most of the century plants and representives of other families; house number 5 contains the cactuses, the crassulas and their relatives, the aloes and other fleshy plants; the contents of houses number 11 and 12, operated as temperate houses, have not yet been arranged into groups; house number 13 contains representatives of a number of tropical families.

Awaiting the completion of the propagating houses it has been necessary to use until within a few days parts of houses 12 and 13 for the growth of seeds and cuttings, so that no permanent arrangement in them has been as yet practicable.

10. *The Propagating Houses.* These very useful structures were essentially completed during the first week in the year, so that we have now been able to remove to them nearly all the seedlings, cuttings and duplicates not desired for exhibition in the main conservatories.

11. *Miscellaneous.* Some planting has been done both in

the spring and fall of a character not falling within any of the categories above mentioned. The primary planting of some of the plots planned for the vicinity of the station was accomplished in the autumn.

The total number of species now available for study in all the plantations, conservatories and in the wild parts of the Park, exclusive of the lichens, fungi, and algae, now aggregates about 5,400.

Further details concerning plants and planting will be found in the reports of Mr. Henshaw, Head Gardener and of Mr. Nash, Curator of the Plantations, hereto appended.

Buildings.

The contract of the Department of Parks with the John H. Parker Company for the construction of the museum building, power house, stable and closet group, was completed in April and the buildings turned over to us for operation by the Department.

Museum. This building has proven to be satisfactory in every way for its purposes. A few minor imperfections in its roof have been corrected by the Parker Company, under their guarantee; some trouble was experienced at first by water in the cellar under the lecture hall after heavy storms, but this has been wholly remedied by clearing the drainage system of obstructions which accidentally got into it while it was being laid, and by grading and the construction of the terraces outside the building. Some trouble has also been experienced from storms driving water under the large window-sills, and this has not yet been wholly remedied, although the conditions have been much improved by additional carpenter work. It was found necessary to supply some additional light-excluding shades in the lecture hall in order to darken that room sufficiently for satisfactory illustration with the electric stereopticon, which was installed and connected with the power cable from the power house. An especially devised case for filing lantern-slides was built by our own carpenter and placed in one of the laboratory rooms on the

third floor; a series of movable wire tables for living plants have been built for use in the physiological laboratory; by means of funds generously contributed by Mr. W. E. Dodge, 12 oak tables carrying 24 microscopes in glass boxes for public instruction have been placed in the west wing of the systematic museum on the second floor; several temporary wooden cases for stacking duplicate and unstudied museum and herbarium specimens have been built for the basement, and others for the storeroom on the third floor.

The exhibition cases in the museum halls of both the first and second floors have been filled with specimens, and the public has had access to these floors every day since the completion of the building, it having been found unnecessary to close the museum at any time for either cleaning or repairs; the cleaning and care of the building has been satisfactorily accomplished by five janitors; the elevator has been run at times when its use seemed desirable, but it has not been necessary to keep it in constant operation, as the visiting public, having only access to the first and second floors, have only to mount two flights of stairs. Access to the building has been restricted to visitors to one of the basement doors pending the building of the paths and driveways to the front entrance; this course has been necessary in order to avoid the tracking of mud into the museum halls. The corps of engineers of the Park Department engaged in the building of roads have been accommodated with a work room in the basement of the eastern wing of the building. Other rooms in this basement wing are used as a label shop and a carpenter shop; two other rooms in the basement are utilized as storerooms, and one main basement hall has been temporarily used as a preparation room for museum and herbarium material. The museum cases on the first and second floors, and the herbarium cases in the herbarium room in the east end of the third floor have hitherto proven sufficient to accommodate the collections, but the growth of the latter has been so rapid that additional cases for all these rooms will probably need to be supplied during the coming year. The number of students

using the laboratories on the third floor has made it necessary to supply additional tables and desks, which have been ordered, and will be available early in the year. The rapid growth of the library has also required additional shelves for the cases in the stack-room; these have been ordered and will be ready to be put in place in a short time; they will accommodate the growth of the collection for a few months, but it is clearly necessary that the walls of the reading room be also shelved during the year, and I have caused a design to be made for this casing by the architect.

Power House. The steam heating apparatus, after some slight changes shown to be desirable by experience in using it, is now apparently satisfactory and sufficient; it has been found possible to heat both the museum building and the conservatories with three boilers out of the five, in any temperature yet experienced, although a fourth boiler has been thrown in at intervals when the temperature fell below 10°, this being, however, apparently unnecessary. A few joints of steam pipe, evidently of imperfect welding, have given away from time to time, but have been promptly replaced either by our own engineers, or by the Parker Company under their guarantee; with such a very extensive system of pipes these defects were to be expected, and could only be discovered by operating the plant. It has been found necessary to supply new grate-bars in some of the furnaces and other new fixtures and fittings, but nothing more than the ordinary working of the steam plant would normally require.

Stable. No changes have been made in this building during the year.

Public Comfort Station. This house built under the Parker contract has not yet been connected with the water supply and with the sewer, and consequently has not been operated during the year. It was planned to make these necessary connections, but more important work required the postponement of this construction.

Tool House. No changes have been made in this building.

The Main Conservatories. The contract of the Department of Parks with John R. Sheehan for the building of eight of the thirteen houses of the main range of Horticultural Houses was completed in June and the buildings were at once accepted by us for operation. Visitors have had access to them every day since their acceptance from 9 o'clock until 5, it not having been necessary to close them at any time. Some difficulty was experienced at first in leakage in the roofs, but this defect was remedied by Hitchings & Company, the builders of the superstructure, and also by the operation of the houses, the constant moisture from within acting to swell the wood in which the glass is framed, so that the roofs are at the present time essentially rain proof. A painter and glazier was employed as soon as the buildings were accepted and has been kept constantly at work in either external or internal painting and in replacing such panes of glass as have been cracked or broken from any cause. The trouble from breakage has been very much less than was anticipated considering the vast area of glass, and such as has occurred seems to have been wholly caused by expansion or contraction, with the exception of one or two panes of glass broken by solid objects blown against the roof in a very violent wind storm during the autumn. An experience with a moderately severe hail storm in the fall, was most satisfactory, the hail stones glancing from the curved glass surfaces without fracturing a single pane; had the glass of the roofs been flat instead of curved there is no doubt that considerable damage would have been done. The heat-radiating surface of the steam pipes within the houses has proved wholly adequate to yield any desired temperature, at any external temperature yet experienced; in fact not more than one-half of it has been used at any time; the great palm house central to the system has proved perhaps the easiest of all the houses to control. Some difficulty was experienced in the early winter by a gaseous emanation from the trench carrying the steam pipes longitudinally under the houses; the exact nature of this gas was not determined; the difficulty was remedied by ventilating the

trench at its southeastern end and by sealing up the manhole covers in the floor of the houses. A defect in the floor of house number 5, due to imperfections in the asphalt, by which water got into the cellar, was corrected by the contractor; defects in the vault lights outside of this house through which storm water was driven into the cellar, have been partially remedied by our own engineers and can probably be completely remedied after the next storm, when it has shown exactly where they are located; a defect in the floor of house number 4 which is built on filled ground, caused by the failing of the contractor to properly stamp the filling, has caused a sinking of the paths within that house and of certain portions of the floor itself together with a parting by a few inches of the rain water leaders from the roof. This can only be remedied after the full amount of settling has taken place, when the paths will probably have to be partly relayed and the floor partly re-constructed. A defect in the feed-water heater in the basement of the west vestibule has been corrected by the contractor under his guarantee.

The floors of houses nos. 1, 4 and 11 were made of broken stone, of which a little more is still needed for a finish; the floors under the benches in houses nos. 3, 4, 12, and 13 were made with good soil, and variously planted. The plant benches in these houses were surfaced with a bottom layer of cinders and a top layer of fine crushed gneiss rock. All this work was done with our own force, it not having been included in the Sheehan contract.

New Railway Station. The New York Central and Hudson River R. R. Co. is constructing a new station on the site of the old one and has changed the name, according to our request, from Bedford Park to Bronx Park (Botanical Garden). It is expected that this structure will be completed late in the winter.

Propagating Houses. A contract was awarded by the Commissioner of Public Parks in August to Hitchings & Company for the building of three of the four propagating houses together with the potting shed planned, for $16,362, and work

was at once commenced on them on the site indicated by our general plan, on the east side of the Garden near the stable and nurseries. These buildings are now completed and are being operated by us, although awaiting some slight changes to be made by the contractor, they have not yet been formally accepted by the Park Department.

Drainage and Sewerage.

In connection with the building of roads, the Department of Parks constructed large earthenware pipe land-drains along the driveways built during the year together with numerous surface basins, all essentially as contemplated in our general plan. I have supplemented this work by the construction of several additional surface basins to drain low places near the driveways. Two main drainage systems have thus been established, the one extending from the triangle south of the museum building northward to the railroad station, the other extending from a point east of the curve in the Southern Boulevard northeast to the western lake; a portion of the roof water from the museum building now flows into this second system; as soon as the final grading along this line is accomplished, sufficient water will be supplied from ordinary rain storms to fill the two lakes. The eastern one of these two lakes nearly east of the museum building has been made by merely overflowing the former marsh at this place, by means of a dam at its eastern end; an iron drainage pipe with a water gate has been placed in this dam in order to permit the drawing off of the water should occasion require it. The western lake has never yet been completely filled with water, owing to the deficiency in rainfall since the portion of the main driveway separating the two lakes, and serving as a dam for the western one, was completed. The two lakes are connected through the embankment of the driveway by an iron pipe also with a water gate, and an overflow earthenware pipe has been laid through the embankment at a level calculated to give about 4 feet of water in the western lake, at its deepest point; it may, per-

haps, be found necessary to excavate the bottom of the marsh here to some extent.

A modification of the roof drainage of the power house which was, last year, temporarily laid into a cesspool, was found necessary during the autumn, and it was diverted temporarily into an earthernware pipe opening on the surface of the ground near the southwestern corner of the Garden; the storm water from the Southern Boulevard, which had given us considerable trouble around the power house, was temporarily diverted by an open ditch to near the same point. The whole system of land drains south and west of the Southern Boulevard which will be built during the construction of the new driveways in that part of the Park, will necessarily supply a permanent outlet for this drainage.

Water Supply.

No extension of the system of water pipes has been made during the year. Provision for a considerable amount of additional pipe has been made in the new contracts for grading and road building about the conservatories and the museum building. It is very desirable that the system should, if possible, be extended this year to and across the Bronx River so far as the stable and the propagating houses; the best method of accomplishing this is not yet apparent; it has not yet been possible to include it in any city contract.

Grading.

Grading operations outside the lines of building and road contracts have been prosecuted by means of our teams and laborers throughout the year, carrying out the provisions of the general plan.

A slope has been nearly completed along the south side of the Southern Boulevard opposite the power house, thus masking and supporting the high stone wall which formed the southern side of the road embankment at this point: it was found impracticable to finally complete this slope, however, in advance of the building of the new traffic road which is

to replace the present Southern Boulevard through the grounds.

Terraces were built and sodded around both ends of the museum building, greatly improving the immediate surroundings of that building.

The land between the museum building and the station was brought to a finished surface and sown, except along the margins of the paths and driveways where it was sodded.

Some additional excavation has been done at the rear of the museum building, but only sufficient to effect satisfactory drainage.

The land between the station, the Southern Boulevard and the piece of driveway connecting the Southern Boulevard with the plaza facing the station, has also been brought to an approximately finished surface and sown. The land immediately east of this piece of driveway has also been partially graded.

Some work has been done in establishing the subgrade of the path planned to extend from this piece of driveway southeast toward the Hemlock Forest, but the completion of this work has been deferred until the architectural features contemplated in front of the museum are executed.

The slope from the museum building east to the main driveway has been partially made and some work has been done at other points along this driveway to make it secure from storm water during the winter; the swampy piece of ground which formerly existed at the point where this driveway connects with the Southern Boulevard has been filled; the triangle formed by the intersection of the driveways south of the museum has also been filled, brought to a finished surface and sown.

Considerable work has been done in completing the terraces around the main conservatories, the portions immediately against that building having been brought to a finished surface and sown; work is still progressing here, to meet the new contract for grading and road-building in that part of the Park.

The immediate surroundings of the propagating houses have also been graded by means of laborers and teams kindly placed under our direction for about a month, by Mr. Peter Gecks, Superintendent of Parks of the Borough of the Bronx.

The new contracts for road building and grading now awarded or in preparation by the Department of Parks will satisfactorily complete nearly all the work of that kind in the vicinity of the main buildings contemplated by the General plan.

Roads and Paths.

Work on the contract awarded by the Commissioner of Parks to John B. Devlin in November, 1899, alluded to in my last annual report, was commenced in the spring and has since been continuously prosecuted. It is now nearly completed but the final surfacing of part of the roadway built under its provisions must be deferred until warmer weather. The execution of this contract has given us Telford-McAdam driveways from the Southern Boulevard near the Power house, past the station plaza, previously built, and around the museum building to the lakes; also from near the museum building to the Southern Boulevard near the herbaceous grounds, a total length of about 4,000 feet.

By means of another unexpended balance in an appropriation for the improvement of existing roads, the Commissioner of Parks awarded in September, a contract to the John J. Hart Co. for the construction of driveways, connecting with the Devlin contract, above alluded to, at the lakes, extending over the Bronx River across the "blue bridge," at the northern end of the Hemlock forest, thence eastwardly across the Garden to the Bleecker Street entrance at the stable; also the construction of the driveway from near the stable to the Lorillard Mansion, within the Garden reservation, and thence through park land to the Pelham Parkway. The western portion of this road, which is actually indicated as a path on our general plan, has been built only 16 feet in width, the ultimate design being to have it revert to a path after the

broad driveway, contemplated by the general plan, running through the fruticetum, across the river above the "blue bridge" and thence to Bleecker Street, is constructed. The portion, however, from Bleecker Street to the southern boundary, has been built full width just as called for by the general plan, with the exception of a few hundred feet near the Lorillard Mansion where the roadway was narrowed in order to save existing trees. The cost of this Hart contract will be about $13,000; work is being continued on it under considerable disadvantage during the winter, but it should be completed very early in the spring. The length of this road within the Garden is about 3,600 feet; it extends beyond our southern boundary past the Lorillard Mansion to Pelham Parkway, furnishing a very beautiful drive.

Under an appropriation of $200,000 made by the city during last year, finally confirmed by the Board of Aldermen on December 11, 1900, the Commissioner of Parks awarded to Mr. John B. Devlin on January 3, 1901, a contract for the building of the driveways and paths, around the conservatories, south and west of the Southern Boulevard, in accordance with the plan formerly approved by him and by the Board of Managers. This contract provides for the building of a traffic road from the power house along the southern boundary of the Garden, about 40 feet from the property of St. John's College to the Southern Boulevard where that road enters the Garden from the south; this traffic road will replace the straight portion of the Southern Boulevard as it now runs between the conservatories and the museum; the contract will also provide a park driveway between the conservatories and the St. John's College property, as indicated on our general plan; it also provides for all the grading necessary to place the conservatories on a low terrace, as originally designed, and for the reconstruction of the area through which the straight portion of the Southern Boulevard now runs, to approximately its original surface, by filling in over the old road, and other modifications of the present surface. It is believed that in the development of the Garden this is one of

the most important pieces of construction work yet undertaken; it should be completed under the terms of the contract in about a year. The approximate cost of the work, based on the contract as awarded, will be $62,000.

As opportunity has been afforded, our own laborers and teams have been occupied during the year with the building of portions of the paths near the railroad station and the Museum building; about 400 feet of finished path has been thus constructed and about 900 feet additional has been laid up with stone without final surfacing; the subgrade for several hundred feet in addition has also been approximately made.

A temporary cinder road has also been built from the stone driveway leading to the Lorillard Mansion, to the new propagating houses, by the aid of the laborers and teams kindly furnished by the Superintendent of Parks.

A contract is being printed, under the $200,000 appropriation above mentioned, for the construction of the driveway approaches to the front of the museum building, including the grading of the rough knoll, now an unsightly feature of that part of the grounds, and also including the architectural additions in front of the building, with the exception of the large fountain, contemplated by plans already approved; the foundations, water connections, and basin of the large fountain are, however, included in this contract. It is expected that this contract may be advertised for bids within a few weeks.

A delivery road to the rear door of the museum building, from the driveway east of it, has been partly graded, but not yet completely constructed.

A temporary cinder road from the Southern Boulevard to the power house, for the delivery of coal, has also been built; also a temporary cinder path from the Southern Boulevard to the main door of the conservatories.

In all the work of construction I have had the most cordial coöperation of Hon. August Moebus, Commissioner of Parks of the Borough of the Bronx, of his Engineer-in-Chief, Hon.

Martin Schenck, and of his Chief Clerk, Mr. Gunther K. Ackerman; to these gentlemen I desire to express my sincere appreciation of their aid and advice.

Care of the Grounds.

The rapidly increasing number of visitors has made it necessary to pay somewhat more attention to the care of the grounds, although no depredations worthy of remark have been committed. Especial watch has been kept on the hemlock forest and the scattering of refuse by visitors has been considerably reduced. In addition to the police patrol the plantations and the forest have been guarded on Sundays and holidays by some of our own men, while others have been kept on guard in the museum building and in the conservatories; it has been possible to arrange this without throwing continuous holiday work on any one person. Some member of the staff has been in charge of the institution on every Sunday and holiday.

The grass of the Garden was cut by our own force in the summer and stacked for fodder for the horses, most of it being put into a hay-barrack built by our own men near the stable; this hay-barrack was constructed with four locust logs for uprights, about 30 feet high, which support a roof which may be raised or lowered at will, a floor of rough logs being added; this has the advantage of keeping both the bottom and the top of the hay-stack free from dirt and water.

Lawn-mowers have been used on the newly sown grounds, and around the plots in the herbaceous garden; the undeveloped meadow areas of the Park were cut with an ordinary two horse mowing machine.

Considerable work has been done in clearing dead branches from trees and a few dead trees have been cut down; this work may go on during the rest of the winter.

Library.

The growth of the library has been very rapid, by gifts, exchanges and purchases. As appears from the report of

the Librarian, hereto appended, the number of books added during the year aggregates 1,415 volumes, besides several thousand pamphlets and parts. The Special Book Fund referred to in my last annual report, subscribed by members of the Board of Managers and other friends of the Garden, has been useful and has enabled us to secure over 600 volumes, many of them of great value in our work; a small balance of this fund still remains unexpended.

Additional exchanges for garden bulletin and contributions have been arranged with a number of journals and societies, the number of journals and publications of societies or institutions now regularly received from all sources, being over 250. The cataloguing of the Library has progressed satisfactorily, the number of cards written during the year being about 4,000. The accession of works on Agriculture and Horticulture, on which considerable work was done in 1899, has been further prosecuted during the past year.

Museums and Herbarium.

The installation of the public museums on the first and second floors of the museum building was commenced in the spring immediately upon the completion of the Parker contract for the construction of the building, and by the middle of the summer a temporary arrangement of the available specimens, than at hand, had been made in the cases on those floors. Since this preliminary arrangement work has been continuously prosecuted in increasing the exhibits, in labelling them, and in substituting for the specimens first installed, others illustrating the plant or the product in a better way.

The herbarium room at the eastern end of the third floor was also occupied early in the year, the herbarium of Columbia University having been completely moved to this room by the end of January. Work in conserving and arranging it and also the collection accumulated by the Garden, has gone on continuously during the year and much progress has been made in making the specimens more available and useful to students. The reports of the Curator of

the Museums and the Curator of the Economic collections, hereto appended, describe this work in detail; the number of specimens added to the museums and herbarium collections during the year is over 50,000 and the number of specimens mounted for the herbarium is about 112,000, a large number of specimens received during previous years having been mounted during 1900.

I have accepted from Columbia University, acting for Barnard College under the agreement entered into between the Board of Managers and the Trustees of Columbia College, Jan. 8, 1896, and the subsequent memorandum adopted by both corporations in 1899, the herbarium formed by the late Dr. Thomas Morong, the property of Barnard College. This collection will be mounted and incorporated with the Columbia Herbarium, already on deposit at the Garden, in so far as the specimens do not duplicate those of the latter.

Laboratories.

The equipment of the laboratories has gone forward as apparatus and supplies have been needed for the research work of students and of the staff; as appears from the report of Dr. MacDougal, hereto appended, 28 regular students have been accommodated; in addition to these, laboratory facilities for short periods of time have been supplied to specialists from other institutions who have wished to use the facilities afforded by us in their investigations.

Lectures.

A course of public lectures on Saturday afternoons, to which all members of the Garden have been specially invited, began on April 14th and extended until June 23d; a second course, commencing October 13th, extended until November 27th; the two courses comprised seventeen lectures; these were well attended, the largest audience numbering nearly 500 persons, the smallest about 75; the subjects of these lectures were duly announced in the monthly Journal. The lecture hall has proven satisfactory in every way, since its

equipment with the electric stereopticon and light-excluding shades; in addition to the use of the lantern some of the lectures have been freely illustrated by living plants brought from the grounds and conservatories.

The appreciation of these lectures by our members, and by the public, makes it desirable to increase the number to be delivered this year; the invitations to our members to visit the Garden on Saturday afternoons in advance of the lectures has been taken advantage of by many, who have thus kept in touch with the development of the institution. No evening lectures have yet been attempted.

Publications.

Bulletin No. 5, including reports of officers and committees for the year 1889, together with five scientific papers written by members of the staff, was issued March 30, 1900; this will complete the first volume.

The monthly Journal has been regularly issued from January to December, together with an index, under the editorship of Dr. MacDougal. Its contents have been restricted to articles and reports bearing on the work of the Garden, together with a detailed list of accessions to the several departments. The Journal has proved to be a very valuable medium for informing our members, and others interested in our work, about the progress in developing the Garden, and it might be somewhat enlarged to advantage, inasmuch as there is an abundance of interesting material available to fill its pages.

The first volume of the Memoirs, containing the catalogue of the Flora of Montana and the Yellowstone National Park, prepared by Dr. Rydberg, assistant Curator of the Museums, was issued on February 15th. This document included an unexpectedly large amount of new scientific information and is a valuable contribution to our knowledge of the flora of the northern Rocky Mountains.

Under the title of Contributions we have issued ten reprints of papers written by members of the staff of the Garden

printed in other periodicals; these have been consecutively numbered and many of them have been distributed to our correspondents; most of the pamphlets and books received by members of the staff in exchange with other investigators have been turned into the Garden Library, and this is an important means of keeping the library supplied, without cost, with the recently-published papers of many botanists.

Meteorological Observations.

Meteorological Stations were established on April 1st at (1) Herbaceous Garden, where a raingauge, maximum and minimum thermometers, and a thermograph were installed; (2) in the Hemlock Forest, a thermograph; (3) Fruticetum, a thermograph. Station 3, which was established for comparison with Station 1 was abandoned after six months. The principal data obtained have been published monthly in the Journal. The thermometric apparatus was housed in standard instrument shelters, U. S. Weather Bureau pattern.

Thermometers, hygrometers and thermographs have been used continuously in the conservatories and propagating houses, and their records tabulated.

Investigations.

Although but a few months have elapsed since the laboratories, library, and collections have been accessible and fully open for use, yet a number of researches have been brought to a successful termination and the results described in publications of the Garden, or other periodicals.

Some of these investigations were begun elsewhere and finished in the Garden, but many of them were carried forward from their inception upon material furnished by the Garden, and by the aid of its other facilities.

The accumulation of living material in the conservatories, and the completion of the propagating houses furnish the widest opportunity for cultural tests of all kinds, and place at our command the means for experimental work upon all of the more important questions in botany.

Professor L. M. Underwood, of Columbia University, has

continued his studies on the ferns and fern-allies of North America, and also investigated certain families of fungi, making use of the abundant material in the Ellis Herbarium.

Dr. H. H. Rusby, Curator of the Economic Collections, has continued his investigations of problems relating to Economic Botany and his studies upon the flora of Boliva.

Dr. D. T. MacDougal, First Assistant, has published several papers upon the nutrition of plants, dealing chiefly with mycorrhizas, and has continued his work upon the relations of plants to light, and upon the climatic relations of plants.

Dr. J. K. Small, Curator of the Museums, has continued his work on the flora of the Southeastern United States. His manual of this flora is now in press.

Dr. P. A. Rydberg, Assistant Curator of the Museums, has published a series of studies upon the flora of the Rocky Mountains upon which he is yet engaged.

Mrs. E. G. Britton, voluntary assistant, has continued her investigations of American mosses.

Mr. R. S. Williams, Museum Aid, has classified the large collections of mosses made by him in the Yukon Territory and in Montana.

Mr. Percy Wilson, Museum Aid, has pursued studies upon trees of the walnut family and upon the local flora.

Prof. F. E. Lloyd, of Columbia University, has studied the embryology of the Rubiaceae and allied groups made an arrangement of the Lycopodiums of North America, and brought out other papers of general interest.

Dr. M. A. Howe, of Columbia University, has been occupied with researches upon the Hepaticae, having brought out in *Memoirs of the Torrey Botanical Club* a fine volume on the Californian plants of that group; more recently he has devoted himself to the critical study of Algae.

Mr. Geo. V. Nash has pursued studies upon numerous horticultural problems, and also upon the taxonomy of North American grasses. He contributes the descriptions of grasses to Dr. Small's Manual of the Flora of the Southern States, and to my Manual of the Flora of the Northern States and Canada, both of which are in press.

Dr. David Griffiths, student, carried out an extensive study of the Sordariaceae, a family of minute fungi growing on decaying animal matter.

Dr. Tracy Hazen, student, has been busy with an arrangement of the Confervae, a group of light-green Algae of this region.

Mr. J. E. Kirkwood, student, has been concerned chiefly with embryological questions, especially on plants of the squash family, but has carried to an advanced stage a chemical study of germinating cocoanuts.

Miss Sarah H. Harlow, student, made a study of the mycorrhizal roots of a number of plants including those of the hemlock from our forest.

Mr. F. H. Blodgett, Museum Aid, has investigated the fungus diseases of carnations, a study commenced at the New York Agricultural Experiment Station, and also certain morphological features of *Erythronium*.

Mr. Chas. W. Gilman, student, has been engaged in classifying collections of local mosses and others from the State of Washington.

Mr. R. M. Harper, student, continues his studies upon the flora of Georgia, having spent a portion of the summer collecting in that State by means of financial assistance kindly furnished by Judge Brown.

Miss R. J. Rennert, student, made an extended study of the transpiration of twigs and buds in winter.

My own original studies have been mainly directed towards a better knowledge of the plants of Northeastern North America, though I have given considerable attention to the flora of Porto Rico, based on the specimens secured through the Vanderbilt exploration fund, and also to the collections made in the Yukon Territory by Messrs. R. S. Williams and J. B. Tarleton. I have given all the time possible to the assistance of other members of the staff and students in their investigations. Care has been taken that the research work of the members of the staff should not interfere with their administrative or curatorial duties.

Reports Appended.

I submit, also, reports by the Curator of the Museums and Herbarium, the Curator of the Economic Collections, the Director of the Laboratories, the Librarian, the Curator of the Plantations, the Head Gardener, and a Schedule of Expenditures under appropriations by the Board of Managers.

Respectfully submitted,

N. L. Britton,
Director-in-Chief.

REPORT OF THE CURATOR OF THE MUSEUMS.

TO THE DIRECTOR-IN-CHIEF.

Sir: I have the honor to submit herewith my report as Curator of the Museums and Herbarium for the year 1900.

At the beginning of the year we were still carrying on most of our operations in the temporary office building in the village of Bedford Park. The work that occupied us throughout the year, in addition to the actual task of installation, was in great part a continuation of that outlined in my last annual report, together with that arising from various problems which presented themselves in the course of the development of the whole museum project.

Museums.

1. GENERAL ACCESSIONS.* Both before and after the actual installing of the exhibits began, the accumulation of museum material was continued as heretofore, by gift, purchase and exchange, and by the personal collection of members of the staff. The objects thus brought together during the year aggregate to 2,342. They represent both crude plant materials and more or less refined or manufactured products.

2. PREPARATION OF MATERIAL FOR EXHIBITION. This branch of our work was mainly a continuation of the operations on this line last year: glass jars, exhibition blocks and exhibition cards, as described in my report of last year, were secured in the following quantities:

a. Glass jars. (Specimen jar, 2,605, Whitall, Tatum & Co.).

Diameter.	Height.	Number of Jars.
3 inches.	8 inches.	120
3¾	10	204
4½	12	276
6	15	12
6	18	36
		Total, 648

* For detailed list of accessions, see Journal of the New York Botanical Garden, 1: nos. 1–12.

b. Exhibition blocks. (Ebonized after being received from the manufacturer.)

Width.	Length.	Number of blocks.
4 inches.	4 inches.	150
4¾	4¾	150
5½	5½	150
7	7	50
	Total,	500

c. Exhibition cards. (For general museum purposes, and for the specimens to illustrate the flora within a radius of 100 miles of New York City.)

Size of cards.	Number of cards.
13¾x18¼ inches.	1800
14 x 22	800
11 x 14	200
11 x 11	100
Total,	2900

d. Frames for the exhibition cards. These represent a very valuable addition to the museum equipment. The use of these frames gives the exhibition cases a finished appearance which could not otherwise be obtained, and also serves to increase the instructiveness of each specimen by separating it off clearly from surrounding objects. The material from which the frames are made is an oak moulding of a slight and neat pattern. As an experiment 300 frames and about 515 feet of the moulding were used and the results were wholly satisfactory.

3. Installation. Early in the year, after the steam-heating apparatus had been perfected to such an extent that all danger of the temperature of the exhibition halls and smaller rooms falling below the freezing point was passed, the accumulations of exhibits were brought from their several temporary quarters and stored at convenient points in the museum building. As soon as the exhibition cases were in position, the museum material already prepared was unpacked and the actual installation begun.

Previous to this, however, after consultation with the Director-in-Chief, a definite plan of arrangement was studied out. In the first place it was decided to throw open all the exhibition halls from the very beginning and not to shut off portions by temporary partitions as is customary in the first stages of many museums. The wisdom of this course has been amply proved. Upon the decision of this question, came the problem of what the different halls should contain. According to the general plan for the arrangement of the museum, previously adopted by the Scientific Directors, the first floor of the building was set aside for an economic museum, while the second floor was set aside for a general synoptic museum and closely related collections.

I. Economic Museum.* The economic collections are now disposed as follows:

a. The hall of the main building east of the center, is occupied by drugs and drug plants. Twenty-four cases arranged in six blocks, are devoted to the drug collection. The specimens are divided into two series, crude drugs and refined drugs. The crude drugs are now arranged morphologically, beginning with the roots and rootstocks and passing through the different parts of the plant, as stems, barks, leaves, inflorescence and flowers, to the whole plant. The refined drugs are first divided into products, the products then are arranged according to the natural families. One block of cases in this hall is now devoted to a collection and exhibit of the local poisonous plants.

b. The woods and wood products occupy the hall of the east wing. They are disposed in twenty cases which stand in seven blocks. One case is devoted to miscellaneous wooden objects and utensils, one to carbons, eighteen to specimen-blocks of the wood from each different kind of North American tree, two to Asiatic woods, one to Porto Rican woods, two to Venezuelan woods, one to pipes and their derivation and one to canes, both crude and finished.

* For other notes on the Economic Museum, see the Journal of the New York Botanical Garden, 1: 115–120 and 133–138.

c. The hall west of the center has been equally divided between two distinct collections: Fibers occupy twelve cases in three blocks on the south side of the hall; nine cases are devoted to crude fibers and their products, two to wood-paper and straw-paper and one to cork. The cork exibit is augmented by a splendid specimen of a cork-jacket from a tree about two and one-half feet in diameter; this specimen is mounted on a large wooden base.

Opposite the fibers, on the north side of the hall, stand an equal number of cases arranged in blocks corresponding to those on the south side; these are devoted to foods and food-plants. For the present the foods are mainly divided into three groups: dry seeds and fruits, fleshy seeds and fruits, and herbs or such parts of herbs or woody plants, other than seeds and fruits, as are used for foods.

d. The west hall is devoted to miscellaneous collections. One case contains the turpentine and rosin exhibit. Three cases are devoted to gums and resins, two to fodder-grasses and fodder-plants, one to unrefined and refined sugars, one to tobacco, two to volatile oils, one to fixed oils, one to starches and one to chocolate. Tea, ginger and ginger ale and vegetable juices occupy one case; another case contains barley, malt, beer and ale; another, unfermented grape juice and wines. One case is given over to cinnamon, both the true and the false, one to a large collection of spices, one to licorice roots and various forms of refined licorice, and one case to miscellaneous objects, including a series of those vegetable products used in making soaps and insect powders.

The various exhibits have been supplemented by series of plates, photographs or drawings in such cases as we have been able to obtain them.

II. SYSTEMATIC MUSEUM. Three more or less independent collections are now installed and make up the systematic museum:

a. A general synoptic collection, arranged to illustrate the vegetable kingdom from the lowest or most simply organized plants to those most highly specialized.

The foundation of this collection is a series of types consisting primarily of a specimen of a plant, supplemented, when possible, by a plate, drawing or photograph. These objects stand against the backs of the cases. On the shelves in front of these specimens are arranged other objects, either dry or in fluid, as flowers, fruits, sections of wood and fossils, to further illustrate the characteristics of the various groups.

In order to make the disposition of this, the largest and most important collection on the second floor of the building, as natural as possible and also convenient and intelligible to the visiting public as well as to students, the exhibition cases near the top of the staircase by which most of the visitors reach the second floor, were selected as the starting point for the series of types. Here are located the most lowly organized plants, whence the gradually more complex groups follow, in a general way, the walls of the building, until the most highly organized plants are reached at the head of the staircase by which visitors naturally leave the floor.

The present installation is as follows: One case (the first) contains the myxomycetes or slime-moulds. The seven cases following this are devoted to that vast group the algae or sea-weeds. Seven cases following these contain the various groups of the fungi. Three cases are devoted to the lichens, two to the hepatics, four to the mosses, three to the pteridophytes, three to the gymnosperms, six to the monocotyledons and thirty-six to the dicotyledons.

b. The Local Flora. In this collection it is intended to show a specimen of each species known to grow naturally within 100 miles of New York City. In cases where it is undesirable or impossible to use the plant itself, the species is represented by a plate, photograph or drawing. This collection occupies the swinging frames which are placed so as to correspond in a general way to the sequence of the cases of the synoptic collection.

In this local collection most of the myxomycetes or slime-moulds, some of the algae, most of the lichens, the hepatics, the sphagna, the mosses and many of the pteridophytes and spermatophytes have been installed.

*c. The Microscopic Exhibit.** This unique exhibit, both conceived and presented by Mr. William E. Dodge, has been temporarily installed in the hall of the west wing, and at present consists of twenty-four microscopes of special design mounted, by pairs, on twelve specially built oak stands. As this collection occupies a hall otherwise containing only cryptogams, it was decided to restrict the objects shown by the microscopes to specimens selected from the plants below the spermatophytes; thus the microscopic exhibit enables the visitor to see the minute structure of the principal groups of the lower plants, from the myxomycetes or slime-moulds to the ferns inclusive. Each microscope is accompanied by an explanatory label referring to the object shown by the instrument.

4. LABELLING. The printing press and outfit added to our equipment last winter has been of great service. The printing of labels has continued nearly throughout the year and the specimens of each exhibit, or some of them, have been furnished with labels giving the data that each one calls for.

Labelling a museum in this way, *i.e.*, by printing each label from loose type, is necessarily a relatively slow process, but it is the only satisfactory way to secure an instructive label, and to say the least, it is the only way to maintain a presentable exhibit. To partially overcome the conditions resulting from this way of labelling, especially in order to make the museum of use to students and of interest to the public generally, as soon as possible, it has been our plan to label small exhibits quite thoroughly, while in the case of large exhibits a certain number of labels are first scattered through the collection and then the gaps are filled out as soon as possible.

A large label is being placed at the top of each museum case in the economic museum so that a visitor can see at a glance what each case contains.

Each family represented in the synoptic museum is being furnished with a label giving information relative to the size

* For detailed descriptions of this exhibit, see Journal of the New York Botanical Garden, 1 : 139-141 and 168-169.

of the family and the geographical distribution of its genera and species.

Specimens in both museums are being furnished with labels referring to living plants in the conservatories and out-door plantations.

5. Care of Collections. The newness of the museums and the necessarily more or less incomplete exhibits, entailed a great amount of moving and readjustment of whole exhibits or individual specimens. Nearly all specimens, subject to the ravages of insects, have been poisoned with carbon bisulphide, chloroform or mercuric chloride, according to the nature of the case. The specimens have repeatedly been cleaned and whenever it has been possible a better or more characteristic specimen has been substituted for a poorer one.

6. Uses of the Museums. Both the economic and systematic museums have been used for some definite purpose by individual students not connected with the Garden, classes from various local schools, whole schools from both New York City and Jersey City, and by the registered students of the Garden as well as the generally interested or mere sight-seeing public. In addition, manufacturers from other cities have consulted different collections of our economic museum from a commercial standpoint.

Herbaria.

1. General Accessions.* During the year 48,895 herbarium specimens from all parts of the world were added to our collections. These were acquired by gift, exchange and purchase, as well as collected by members of the staff.

2. Mounting of Herbarium Specimens. About 67,650 sheets containing fully 112,050 specimens, were mounted and distributed in the herbarium cases. We have now finished mounting and distributing all the specimens belonging to the Jaeger moss herbarium and the Ellis fungus herbarium.

3. Arrangement of the Herbaria.† The herbarium

* For a more extended account of the herbaria, see the Journal of the New York Botanical Garden 1 : 33–38.

† For detailed list of accessions, see Journal of the New York Botanical Garden 1 : nos. 1–12.

room is admirably suited to its purpose and is conveniently divided into three long alcoves by two rows of pillars. Between one row of pillars and the east wall range the cases containing the Garden herbarium, while between the other row of pillars and the west wall stand the cases containing the Columbia University Herbarium. The blocks of cases are placed so as to permit walking completely around them. Through the space between the two rows of pillars and across the north end of the room facing large windows, are two series of tables equidistant from both herbaria.

A herbarium library, being a series or duplicate books from the main library, has been deposited in the herbarium room. Here are kept such books as are constantly needed in connection with herbarium work, thus effecting a saving of time that would need be expended were it necessary to constantly consult the main library on numerous minor yet important points.

a. Garden Herbarium. This collection is rapidly gaining in value and importance. The specimens composing it have been derived from available collections made during the past few years, especially since the foundation of the Garden, from all parts of the world, in addition to miscellaneous specimens and many rare sets of plants of earlier collections fortunately acquired through the accessions of the following collections

The J. B. Ellis herbarium.
The John J. Crooke herbarium.
The F. M. Hexamer herbarium.
The H. E. Hasse herbarium.
The Per A. Rydberg herbarium.
The Lewis R. Gibbes herbarium.
The Peter V. LeRoy herbarium.
The Harry Edwards herbarium.
The Anna M. Vail herbarium.
The Francis E. Lloyd herbarium.

The whole, or such portions, of these collections as were especially needed for study, have now been mounted and incorporated in the main herbaria.

At present the specimens belonging to the Garden herbarium

are almost equally divided in number between the cryptogams and phanerogams.

b. Columbia Herbarium. Additions aggregating about 18,842 specimens were made to this collection during the year. This great increase is due to the acquisition of the Morong herbarium, which is now made a part of the Columbia herbarium, by the action of the Trustees of Barnard Col lege and Columbia University. A conservative estimate of the contents of the Morong herbarium, is 18,000 specimens.

Fully 3,500 sheets, containing about 12,475 miscellaneous specimens were mounted and have been distributed in the cases. These additions are mainly from the Jaeger moss herbarium, but otherwise they are selected and valuable specimens and greatly increase the value of the collection A comparsion of the contents of the Garden harbarium as given above with the present contents of the Columbia herbarium as shown in the following paragraph will show how admirably the two herbaria supplement each other and form together the largest collection in America.

The Columbia University herbarium was begun early in the century by Dr. John Torrey, and contains the material upon which his botanical writings, extending over half a century, were based. On this as a foundation the present Columbia herbarium was built. Mr. John J. Crooke enriched it by two valuable collections; the one that of Professor C. J. Meisner, of Basle, Switzerland, and the other that of the late Dr. A. W. Chapman, of Appalachicola, Florida. A few years later the mosses, and many of the hepatics and lichens accumulated by Mr. C. F. Austin, were incorporated in it, while the quite recent acquisitions of great size and importance, are the famous collection of mosses brought together from all parts of the world by the late Dr. J. G. Jaeger, of Switzerland, and the Morong herbarium. To this ample nucleus, Dr. Torrey's successor, Dr. N. L. Britton, while professor at Columbia, and his associates, added continually by securing collections from all parts of the globe, and by special collecting trips to various parts of North and South America.

4. Uses of the Herbaria. These collections have constantly been used by members of the Garden staff, members of the staff of the Department of Botany of Columbia University, and the students of both institutions, for research work, and special investigations, for museum work, for the comparison of specimens generally, and in connection with the development of the Garden conservatories and Plantations. They have also been used by responsible persons not connected with either institution by permission of the Director-in-chief. Many officers and students of other institutions both in this country and abroad have consulted the collections.

5. Special Collections. At the request of the Professor of Botany of Columbia University, we have undertaken the preparation of two teaching herbaria, one for the Department of Botany at Columbia and one for that of Barnard College. These collections are to take the place of the herbaria of both those institutions now in deposit at the Garden. Many specimens have been selected from our duplicates and reserved for these collections.

6. Assistance. The museum aids assigned to my department have performed their duties faithfully, and the hearty coöperation of other members of the staff has aided much in advancing the work of this department.

Dr. Rydberg, Assistant Curator, has carried on the practical work of the herbarium. Special and noteworthy aid has been received from Mrs. N. L. Britton and Prof. L. M. Underwood both in the direction and prosecution of mechanical work, in connection with the groups of plants in which they are respectively interested. Mrs. Britton as heretofore, has taken charge of the mounting and distribution of the specimens of mosses, while Professor Underwood has acted in the same capacity during the mounting and distribution of the specimens from the Ellis fungus herbarium.

Respectfully submitted,

J. K. Small,

Curator of the Museums and Herbarium.

REPORT OF THE CURATOR OF THE ECONOMIC COLLECTIONS.

To the Director-in-Chief.

Sir: I have the honor to submit herewith my report as Curator of the Economic Collections for the year 1900.

The year has been a successful one in this, as in the other departments of the Garden, both as to the development of the collections and the public interest which has been manifested in them.

Since the presentation of my last report, nearly one-half of our cases have been installed, and most of these are now comfortably filled with exhibits. Detailed lists of these exhibits have been regularly published in our Journal under the title "Lists of Accessions." Further information upon this subject has been incorporated in two articles published in our Journal as follows: "The Economic Museum," Vol. 1, No. 8, August; "Exhibits in the Economic Museum," No. 9, September. Copies of these two articles are filed, together with this report. Reprints of the same have been extensively and successfully utilized in affording information to those who have been invited to contribute exhibits.

Most of the collections received during the past year represent donations, though extensive series have been received in exchange from the Philadelphia Museums and Field Columbian Museum of Chicago. The materials represent a wide variety as to class. The different classes have been separated into special cases or groups of cases, so that a rough classification exists in the museum. This classification, however, is still to be regarded as temporary. A final and satisfactory one is not practicable until a larger portion of the principal bulk shall have been secured, and deposited in the cases. A great improvement, facilitating inspection by the public, has been made by placing large signs upon the tops of the cases, indicating the general nature of their contents, such as "Sugars," "Starches," "Fixed Oils,"

"Volatile Oils," etc. A large part of the individual exhibits have already been labeled, though several hundred still remain without their labels; the manuscript for these labels is in the hands of the printer.

The collection of local material in the vicinity of the Garden has been small in amount during the past year, since the greater part of these collections had already been made.

The exhibits which have been actually secured represent only a portion of the year's work, for many exhibits, some of them of great extent and importance, have been contracted for, and are now either in course of preparation or awaiting the convenience of those who have promised them. During the last two months of the year, it has been extremly difficult to obtain anything more than promises of future assistance, the extensive business revival, and the duties pertaining to the closing of the year, having left our friends with little leisure to devote to the preparation of such special exhibits as our interests require. Several of these expected exhibits are worthy of special mention, as follows:

The preparation of the very large collection of drugs promised from Messrs. Merck & Company of Darmstadt and New York has been delayed, owing to the occurrence of the Paris Exposition during the past year. Doctor Merck, the head of the house, expressed a desire to personally superintend the preparation of this exhibit for us, but, since he was the President of the German section of the Paris Exposition, he requested to be excused from undertaking our commission until that enterprise should have ceased to occupy him.

That part of the exhibit promised by Messrs. Francis H. Leggett & Company which relates to spices has been received, and constitutes a prominent and highly instructive part of our collections. It is hoped that other portions of this exhibit will shortly be deposited in the museum.

The promised exhibit from the Crude Rubber Company has not yet come to hand, although we have positive assurance that its preparation is only temporarily delayed.

An extensive series of specimens representing the manu-

facture of spool cotton thread is in course of preparation by the Clark Thread Works of Newark, New Jersey.

Messrs. Travers Brothers of New York have promised a similar exhibit of rope and twine.

The Barbour Flax Company has donated a small collection representative of the linen thread industry, and have promised to replace it by a more extensive one, as leisure permits.

The department is also awaiting with great interest the extensive series of collections obtained by yourself upon your recent visit to Paris.

An important step has this year been taken in the direction of the special industrial exhibits, to which reference has been made in previous reports, the Whiting Paper Company of this City having offered to build for us a miniature paper mill, provided that we will supply a suitable case for the same. Mr. Whiting and his manager have together visited our museum, and an agreement has been reached in regard to this subject.

Arrangements have been partially made for securing two other special exhibits of this character.

Respectfully submitted,

H. H. RUSBY,

Curator of the Economic Collections.

REPORT OF THE DIRECTOR OF THE LABORATORIES.

To the Director-in-Chief.

Sir: I have the honor to present the following report for the year ending January 1, 1901:

The appropriation of $2,000.00 granted by the Board of Managers, January 8, 1900, for the equipment of the laboratories has been expended in the purchase of additional microscopes, apparatus and supplies demanded by the needs of the investigators in various subjects. Such accessions have been duly recorded in the lists published monthly in the Journal.

In addition to the working outfit, the Garden has acquired by gift from Mr. C. F. Cox of the Board of Managers, a collection of old microscopes which will be arranged as a special exhibit in the laboratories to illustrate the development of this instrument during the last two hundred years.

Accommodations have been provided for a large number of students, engaged in various lines of research under the guidance of members of the staff. The increasing number of applicants for the privileges of the laboratories demands a material enlargement of the equipment during the next year. Some of the investigations undertaken have been finished and their results have appeared in various publications of the Garden and other journals. A number of botanists from various parts of the country have made brief visits for the purpose of consulting the collections or using the apparatus. The following persons have duly registered for the full privileges of the institution:

Howard J. Banker, A.B., Syracuse University, 1892.
May Banta, B.S., Wellesley College, 1889.
Alice Irene Barrett.
Frederick H. Blodgett, B.S., Rutgers College, 1897; M.S., 1899.
Anna Priscilla Braislin, A.B., Vassar College, 1897.
Louise Bruchmann, Normal College.

W. A. Cannon, A.B., Stanford University, 1900.
Elizabeth Carss, B.S., Cornell University, 1895.
Bertha McLane Dow.
Alice Dufour, PhB., Defiance College, 1899.
Louise Brisbane Dunn, A.B., Columbia University, 1898; A.M. 1899.
Elon Howard Eaton, A.B., Rochester University, 1890; A.M., 1893.
Charles Winthrop Gilman.
John R. Gardner, B.S., Fayette College, 1890; C.E., Iowa State College, 1894.
David Griffiths, B.S., Agricultural College, South Dakota, 1892; M.S. 1893; Ph.D., Columbia University, 1900.
Sarah H. Harlow, A.B., Wellesley College, 1891.
Roland McMillan Harper, B.E., University of Georgia, 1897.
Tracy Elliot Hazen, A.B., University of Vermont, 1897; Ph.D., Columbia University, 1900.
Nellie Priscilla Hewins, B.S., Cornell University, 1898; A.M., Columbia University, 1900.
Joseph Edward Kirkwood, A.B., Pacific University, 1898; Graduate student Princeton University, 1898-1899.
Elsie W. Kornmann, Normal College.
Elsie Kupfer, A.B., Columbia University, 1899.
Francis Ernest Lloyd, A.B., Princeton University, 1891; A.M., 1895.
Delia W. Marble.
Rosina J. Rennert, A.B., Normal College, 1897.
Florence W. Slater, B.S., Cornell University, 1900.
Ada Watterson, A.B., Columbia University, 1898; A.M., 1900.
Violette S. White.

Total number......... 28.

The custom has been instituted of holding a weekly convention in the conference room of the laboratories, to which all of the active botanists of the city are invited. The results of investigations accomplished here and elsewhere are presented, and the ensuing discussions are highly profitable. Visiting botanists also deliver addresses occasionally upon invitation. The record of subjects brought before the convention may be found in the Journal.

The Journal of the Garden, the publication of which was authorized by the Board of Managers, Jan. 8, 1900, has been issued monthly, and volume I, inclusive of the twelve numbers from January to December, 1900, with an index, comprises viii + 213 pages, 5 plates and 25 figures. An effort has been made to have the Journal give full information as to the progress and development of the Garden in all of its departments, call attention to any special activities of persons connected with the institution, list all accessions, and publish any matter which might be of interest to the members of the Garden. The Journal thus becomes the historical record of the Garden.

Meteorological stations were established in the Herbaceous grounds, hemlock forest, and fruticetum, April 1, 1900, under the terms of a special appropriation by the Board of Managers. These stations not only serve to obtain the records of temperature and rainfall necessary to systematic cultivation, but also furnish important data for the study of the influence of plant coverings and minor topographic features upon climatic conditions.

Some explorations in the Priest River Forest Reserve in Northern Idaho were carried on during July and August by the aid of a grant from the exploration fund. Material assistance in this work was rendered by Mr. Asa Bradrick of Shelbyville, Indiana, and the forest rangers on duty in the Reserve. A collection of the plants was made from which several new species have been described. A small number of seeds and living plants were obtained for the plantations. Thermometric studies to determine the influence of minor topography upon plant distribution, in extension of the work carried on in the Garden and elsewhere by myself, were made under the terms of a grant from the American Association for the Advancement of Science.

The undersigned had the honor to be appointed Acting Director-in-Chief during the absence of Dr. N. L. Britton in Europe, and the duties of that position were discharged from Sept. 22nd to November 10th, 1900.

Comprehensive articles upon the development and organization of the Garden have been published in Science and Popular Science Monthly by invitation. Lectures have been given under the auspices of several institutions and the results of work accomplished in the laboratories have been presented before various scientific societies. The manuscript of an advanced text-book on Plant Physiology, which has been under preparation for several years, has been completed, and is now in the hands of the publisher.

Respectfully submitted,

D. T. MacDougal,

Director of the Laboratories.

REPORT OF THE LIBRARIAN.

To the Director-in-Chief:

Dear Sir: I beg to submit the following report on the Library, covering the period from January 1, 1900, to January 1, 1901:

The botanical library of Columbia University, which was moved on the last days of December, 1899, has been completely shelved and the books have been sorted and classified with those acquired by the Garden since 1896, so that both libraries are arranged in one series, each volume, however, being bookplated so as to be distinguishable. The books were counted as soon as shelved and on February 1st, the bound volumes numbered 7,117 with some 300 volumes at the bindery. Of the vast amount of pamphlet literature, no account was taken. The last census of the books was taken on December 29, 1900, show the numbering then to be 8,832: the increase for the year being 1,415 volumes. Of these, 639 numbers, some of them pamphlets and separates, were purchased by the Special Book Fund, the remainder being acquired by gift or exchange.

The volumes for 1899 of the serial publications deposited by Columbia University have been bound by the University as far as they have been completed, and the Garden has begun to bind these for 1900, in accordance with an agreement between the two institutions.

The loose pamphlets and separates belonging to Columbia University have been sorted and classified and 9 volumes of them as well as a number of single separates have been bound. It is planned to have them all bound ultimately, no matter how small and insignificant.

A copyist has been steadily at work for two months, duplicating the card catalogue of the books deposited by Columbia University and about one-third of the catalogue is ready for use and more than one-half of the books belonging to the Garden are catalogued. A shelf list of the entire Library also has

been completed. It is estimated that about 4,000 catalogue cards have been written for the Garden Library.

A most important and valuable addition to the Library was made by the N. Y. Academy of Sciences, which, during the early part of the summer, deposited the botanical portion of its library at the Garden. About 265 volumes (some of them pamphlets) were put on the shelves and the remainder, being duplicates of books owned either by Columbia University or by the Garden, were boxed and stored. Not the least important part of this library are 26 volumes of pamphlets, the majority of which are out of print and difficult to obtain.

The files of the Bulletins and Reports of the U. S. Agricultural Experiment Station have been steadily increased by purchase and exchange. Attention has also been directed to those branches of literature dealing with Horticulture, Floriculture, Landscape Gardening and Forestry, and numerous purchases have been made.

Accessions to the Library have been published Monthly in the Journal.

List of Exchanges.

Institutions.

Agricultural Experiment Station, Auburn, Ala.
" " " Uniontown, Ala.
" " " Tucson, Arizona.
" " " Fayetteville, Ark.
" " " Berkeley, Calif.
" " " Fort Collins, Colo.
" " " New Haven, Conn.
" " " Storrs School, Conn.
" " " Newark, Del.
" " " Lake City, Fla.
" " " Experiment, Ga.
" " " Moscow, Idaho.
" " " Urbana, Ill.
" " " Lafayette, Ind.
" " " Ames, Iowa.
" " " Manhattan, Kans.
" " " Lexington, Ky.

Agricultural Experiment Station, Audubon Park, New Orleans, La.
" " " Baton Rouge, La.
" " " Orono, Me.
" " " College Park, Md.
" " " Amherst, Mass.
" " " Agricultural College, Mich.
" " " St. Anthony Park, St. Paul, Minn.
" " " Agricultural College, Miss.
" " " Columbia, Mo.
" " " Bozeman, Montana.
" " " Lincoln, Nebr.
" " " Reno, Nev.
" " " Fargo, N. Dak.
" " " Durham, N. H.
" " " New Brunswick, N. J.
" " " Mesilla Park, N. Mex.
" " " Geneva, N. Y.
" " " Ithaca, N. Y.
" " " Raleigh, N. C.
" " " Wooster, Ohio.
" " " Stillwater, Oklahoma.
" " " Corvallis, Oregon.
" " " State College, Pa.
" " " Kingston, R. I.
" " " Clemson College, S. C.
" " " Brookings, S. Dak.
" " " Knoxville, Tenn.
" " " College Station, Texas.
" " " Logan, Utah.
" " " Burlington, Vt.
" " " Blacksburg, Va.
" " " Morgantown, W. Va.
" " " Pullman, Washington.
" " " Madison, Wis.
" " " Laramie, Wyo.

Agricultural Department of the West Indies, Barbadoes, W. I.
American Museum of Natural History, New York City.
Bishop Museum, Honolulu, Hawaiian Ids.

Botanic Gardens, Sydney, New South Wales.
Botanic Institute, Stockholm, Sweden.
Botanical Department, Jamaica, West Indies.
Botanical Gardens, Cincinnati, Ohio.
Botanical Gardens, Trinidad, West Indies.
Botanical Garden of the University of Siena, Siena, Italy.
Brooklyn Institute of Arts and Sciences.
California State Board of Horticulture, Sacramento, California.
Central Experiment Farm, Ottawa, Canada.
Clemson College and Experiment Station, Clemson College, So. C.
Columbia University Library.
Denison University, Granville, Ohio.
Eli Lilly and Co., Indianapolis.
Field Columbian Museum, Jackson Park, Chicago, Ill.
Geological and Natural Survey of Minnesota, Minneapolis, Minn.
Geological Survey of Canada, Ottawa, Canada.
Geological Survey of Maryland, Baltimore, Md.
Herbier Boissier, Geneva, Switzerland.
Herbarium of Harvard University, Cambridge, Mass.
Illinois State Laboratory, Urbana, Ill.
Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa.
Jardin Botanique, Geneva, Switzerland.
Kew Gardens, London, England.
Royal Botanical Museum, Berlin, Germany.
Library of Oberlin College, Oberlin, Ohio.
Missouri Botanical Garden, St. Louis, Mo.
New York Public Library.
New York State Museum of Natural History, Albany, N. Y.
Ohio State University Naturalist.
Royal Botanical Garden, Glasnevin, Dublin, Ireland
Royal Botanical Garden, Calcutta, India.
Smith College, Northampton, Mass.
Smithsonian Institution, Washington, D. C.
U. S. Department of Agriculture, Washington, D. C.
  Office of Experiment Stations.
  Division of Agrostology.
  Division of Botany.
  Division of Vegetable Pathology and Physiology.

Division of Soils.
Division of Forestry.
Weather Bureau and its 44 Sectional Departments.
Monthly Weather Review.
U. S. Geological Survey, Washington, D. C.
U. S. Department of State; Publications of the Bureau of Foreign Commerce.
University Library, Upsala, Sweden.
Victoria Gardens, Bombay, India.

Societies.

Academia National de Ciencas en Cordoba, Buenos Aires.
Académie Impériale des Sciences, St. Petersburg, Russia.
Academy of Natural Sciences, Philadelphia, Pa.
American Association for the Advancement of Science.
American Rose Society, New York.
Appalachian Mountain Club, Boston, Mass.
Biological Society, Washington, D. C.
Botanischer Verein, Landshut, Bavaria, Germany.
Buffalo Society of Natural Sciences, Buffalo, N. Y.
California Academy of Sciences, San Francisco, Calif.
Cincinnati Society of Natural History, Cincinnati, Ohio.
Connecticut Academy of Arts and Sciences, New Haven, Conn.
Davenport Academy of Sciences, Davenport, Iowa.
Edinburgh Botanical Society, Edinburgh, Scotland.
Elisha Mitchell Scientific Society, Chapel Hill, N. C.
Indiana Horticultural Society, Indianapolis, Ind.
Instituto Medico Nacional, Mexico City, Mexico.
K. K. Zool. Bot. Gesellshaft, Vienna, Austria.
Kansas Academy of Sciences, Topeka, Kans.
Massachusetts Horticultural Society, Boston, Mass.
Minnesota Horticultural Society, Minneapolis, Minn.
Michigan Horticultural Society, Lansing, Michigan.
Natural Science Association of Staten Island, New Brighton.
Naturforschende Gesellschaft, Zurich, Switzerland.
New England Botanical Club ("Rhodora"), Boston, Mass.
New York Academy of Sciences, Flatbush, N. Y.
New York Farmers.
New York Zoological Society.
Ohio State University, Columbus, Ohio.

Pennsylvania Forestry Association, Philadelphia, Penna.
Philadelphia Mycological Center, Philadelphia, Penna.
Rochester Academy of Sciences, Rochester, N. Y.
St. Louis Academy of Natural Sciences, St. Louis, Mo.
Sociedade Broteriana, Jardin Botanique, Coimbra, Portugal.
Sociedade Cientifica, Argentina, Buenos Ayres, La Plata, So. A.
Société Botanique, Brussels, Belgium.
Société Botanique, Luxemburg, Belgium.
Société Botanique, "Dodonea," University of Ghent, Belgium.
Société des Naturaliste Luxembourgeois, "Fauna," Luxembourg, Gd. Duchy of Luxembourg.
Torrey Botanical Club, New York City.
Wisconsin Academy of Arts and Sciences, Madison, Wis.
Washington Academy of Sciences, Washington, D. C.

Journals.

American Agriculturist, New York City.
American Florist, Chicago, Ill.
American Gardening, New York City.
American Journal of Pharmacy, Philadelphia, Penna.
American Microscopical Society Journal, Washington, D. C.
Bolletino del R. Orto Botanico di Palermo, Palermo, Italy.
Bolletino del R. Orto Botanico di Siena, Siena, Italy.
Botanisches Centralblatt and Beihefte, Cassel, Germany.
Botanical Gazette, Chicago, Ill.
Botaniska Notiser, Lund, Sweden.
Bulletin of Pharmacy, Detroit, Mich.
Florist's Exchange, New York.
Gardening, Chicago, Ill.
Journal of Applied Microscopy, New York City.
Journal of Pharmacology, New York City.
Meehan's Monthly, Germantown, Penna.
Muhlenbergia, Lancaster, Penn.
Nuova Notarisia, Padua, Italy.
Park and Cemetary, Chicago, Ill.
Pharmaceutical Record, New York City.
Pharmaceutical Review, Milwaukee, Wis.
Revue Bryologique, Cahan, Athis, France.
Rural New Yorker, New York City.
The Plant World, Washington, D. C.
Science, New York City.

Vick's Illustrated Monthly Magazine, Rochester, N. Y.
Zoe.

Periodicals Subscribed for by the Garden.

Biologisches Centralblatt, Leipzig, Germany.
Centralblatt für Bacteriologie, Jena, Germany.
Nature, London, England.
Popular Science Monthly, New York City.
The Forester, Washington, D. C.

Periodicals Subscribed for by Columbia University and Deposited at the Garden.

Allgemeine Botanische Zeitschrift, Karlsruhe, Germany.
Annales des Sciences Naturelles, Botanique, Paris, France.
Beiträge zur Wissentschaftlichen Botanik, Stuttgart, Germany.
Bibliotheca Botanica, Stuttgart, Germany.
Botanische Jahrbücher, Leipzig, Germany.
Flora, Marburg, Germany.
The Garden, London, England.
Gardener's Chronicle, London, England.
Jahrbücher für Wissenschaftliche Botanik, Leipzig, Germany.
Baumgarten's Jahresbericht, Braunschweig, Germany.
Botanische Zeitung, Leipzig, Germany.
Just's Botanischer Jahresbericht, Leipzig, Germany.
Botanisches Centralblatt und Beihefte, Cassel, Germany.
Curtis' Botanical Magazine, London, England.
Berichte der Deutsche Botanische Gesellschaft, Berlin, Germany.
Journal de Botanique, Paris, France.
Linnean Society, Botany, Journal, London, England.
Linnean Society, Botany, Transactions, London, England.
Malpighia, Genoa, Italy.
Société Botanique de France, Paris, France.
Société Mycologique, Bulletin, Paris, France.
Société Royale de Botanique de Belgique, Bulletin, Brussels, Belgium.
Zeitschrift für Pflanzenkunde, Stuttgart, Germany.

Periodicals Received in Exchange by The Torrey Botanical Club and Deposited by Columbia University at the Garden.

American Gardening, New York City.
American Philosophical Society, Philadelphia, Penna.

Annals of Botany, London, England.
Asa Gray Bulletin, Tacoma Park, D. C.
Botanical Gazette, Chicago, Ill.
Forest Leaves, Philadelphia, Penna.
Hedwigia, Dresden, Germany.
Bulletin of the Illinois Laboratory of Natural Science, Springfield, Ill.
Bulletin of the Natural History Laboratories of Iowa University, Iowa City, Ia.
Bulletin of the Botanical Department of Jamaica, Jamaica, W.I.
Botanisk Tidsskrift, Copenhagen, Denmark.
Botaniska Notiser, Lund, Sweden.
California Academy of Sciences, Proceedings, San Francisco, Calif.
Canadian Record of Sciences, Montreal.
Columbus Horticultural Society, Columbus, Ohio.
Bulletin of the Scientific Laboratories of Denison University, Granville, Ohio.
Deutsche Botanische Monatsschrift, Arnstadt, Germany.
Journal of Botany, London, England.
Bulletin of the Royal Botanic Gardens, Kew, England.
Linnean Fern Bulletin, Binghampton, N. Y.
Massachusetts Horticultural Society, Boston, Mass.
Monatsschrift für Kacteenkunde, Neudamm, Germany.
Notizblatt des K. K. Botanischen Gartens, Berlin, Germany.
Nuova Notarisia, Padua, Italy.
Osterreichische Botanische Zeitschrift, Vienna, Austria.
Ottawa Naturalist, Ottawa, Canada.
Pharmaceutical Archives, Milwaukee, Wis.
Pharmaceutical Review, Milwaukee, Wis.
Plant World, Washington, D. C.
Revue Générale de Botanique, Paris, France.
Revue Mycologique, Toulouse, France.
Rome, Annuario del R. Institutio Botanico, Italy.
Journal of the Royal Microscopical Society, London, England.
St. Petersburg Botanical Garden (Acta Hort. Petrop.), St. Petersburg, Russia.
Sociedade Broteriana, Coimbra, Portugal.
Societá Botanica Italiana, Bulletino, Florence, Italy.
Tokio Botanical Society, Botanical Magazine, Tokio, Japan.

Trinidad, Bulletin of Miscellaneous Information, Trinidad, W. I.

Vienna, Zoologisch-Botanische Gesellschaft, Verhandlungen, Vienna, Austria.

Proceedings of the Boston Society of Natural History, Boston, Mass.

Respectfully submitted,

ANNA MURREY VAIL,

Librarian.

REPORT OF THE CURATOR OF THE PLANTATIONS.

To the Director-in-Chief.

Dear Sir: I have the honor to submit herewith my report as Curator of the Plantations for the year just closed:

During the period covered by this report the collections under my control have made much progress, both in growth and in their better display and arrangement. In the matter of growth, many additions have been made, something over 6,000 specimens having been received. This increase is especially marked in the collections of tropical and other tender plants which are many times larger than formerly. The fruticetum also claims a prominent place in the line of improvement, many species new to this tract having been installed, derived from our own nurseries or from outside sources. This, together with the other plantations, will be treated more in detail under the sections of this report.

A large number of plants have also been obtained from seeds secured from various sources. About 2,000 packets have come in during the course of the year, mainly by gift or in exchange. Many of these were of hardy plants for the outdoor plantations and were sown in the nursery; a fair proportion germinated and developed into plants which have been transplanted, mainly to the herbaceous grounds. Some of the seeds intended for the conservatory collections have also been sown, many of them have germinated, and interesting results are expected from a number of plants thus derived. The remainder of the conservatory seeds are awaiting the completion of the range of propagating houses; at such time these will be sown, and as many of them are of plants unusual in cultivation it is hoped that many valuable additions will be derived from this source.

The installation of show labels has been prosecuted to the fullest extent made possible under the circumstances, over 2,000 have been manufactured and placed in position. After considerable experimenting, a system of lettering with

rubber type and adjustable lettering-frames has been devised which gives a rapid, cheap and legible result, all desirable features in a label. The value and importance of this feature of labeling in emphasizing the educational aspect of our collections is continually borne in mind, and is fully appreciated by the visiting public. The matter of providing all plants with record labels is also of much importance, and has been found of great assistance to us in the past. These labels have been made much more efficient by allotting to each a given number, our accession book giving under the same number all available data in reference to the plant. The copper label which we have used on the shrubs and small trees for several years is employed for this purpose and is proving very satisfactory. It is pendant from a wire inserted along the edge of the pot in the rear, and so entirely hidden, thus reducing to a minimum the chance of a mixture of labels by some too inquisitive visitor. It far excels the zinc label formerly used for this purpose. It is hardly necessary to state that the card catalogue of the plants in cultivation is still maintained, its usefulness having been so fully demonstrated in the past. The data from our accession book are being transferred to it as fast as possible. The herbarium of cultivated plants is increasing, many specimens having been added. This will increase more rapidly in the future now that our conservatory collections are growing so rapidly.

In my report for 1899 were given full lists of all the species under cultivation. The preparation of such lists involves much labor and time and to be effective should be approximately complete. Owing to the large accessions of the past six months much time has been consumed in properly recording and installing such additions. This has rendered it impossible to determine many of the plants which have come to us without names, and to properly verify some names about which there is considerable suspicion. It would of course be impossible to incorporate such unnamed material, and for this reason a list made at this time would necessarily be incomplete, and would give an erroneous idea as to the size and

composition of our collections. It has been thought best, therefore, to defer the making of such lists, if they are desirable, until such time as this important matter of determination of the plants can be given due consideration. I would state, however, that every available moment is being given to the study of the collections and their proper naming. If, however, it is desired that such lists be prepared now, such data as are at hand may be tabulated.

In treating the collections more in detail, those which claim our attention first on account of their remarkable growth are those installed in the

Conservatories.

This range of houses went into operation in June, and the task of securing plants to fill them at once commanded our attention. The collections which had been accumulating in the green houses at Columbia University for the past few years were transferred under my direction to their new home toward the latter part of June. While these were of considerable size and filled their old quarters, in the new houses there was ample room for growth after their installation. It seemed a formidable task to secure plants to fill this large area, but much to our gratification a large part of this task was soon accomplished. This happy result was brought about largely by the kindness and generosity of our members, and of other friends, who presented us with many plants and in some cases large collections, thus greatly lightening the work. Exchanges with other institutions have been arranged and consummated by which many other desirable plants have been secured. Most of the larger gifts of plants and those secured by exchange were packed, shipped and installed under my personal supervision, and it affords me great pleasure to state that but a small percentage were damaged in transit, although some of them were moved several hundred miles, and the last accession as late as December, when the danger from cold was an additional menace.

During the past year 3,659 plants have been added to the

collections in the conservatories, these representing many families, species and varieties, natives of many and distant lands, a large percentage of them new to our collections.

The label used here, and which has been very successful thus far, is made of sheet zinc and painted gray. A lip is provided on the upper surface and this is bent back and inserted in the pot or tub, bringing the top of the label flush with the rim of the pot, so that no part of the plant is obscured, an important advantage in the labeling of specimens. As in the other plantations, the label is designed to give the common and botanical names of each plant and its native country, but here, in addition to these, is given the name of the family to which the plant belongs, and also, if it has been a gift, the name of the donor. These labels are of two sizes, the larger one for tubs and large pots; of the larger size 92, and of the smaller 872, have been placed in position, making a total of 964.

The collections have been in great part grouped according to families, making their comparative study much easier, and rendering them much more available for purposes of instruction.

Herbaceous Grounds.

Much has also been accomplished in this plantation. Several new beds have been added, made necessary by the growth and needs of plants already installed and by the addition of new ones. The collections arranged here must from the nature of things be changeable, their complexion varying from year to year. Many plants are unable to stand our climate but for a year or two and then die out, while others show the utmost vigor, evidencing wonderful adaptability for decorative planting. About 1,000 specimens have been added during the year, and of these many are new to the collections or have replaced those which have succumbed to our climate or other adverse conditions. Of the wooden show label used in this tract 817 were made and installed for the individual plants, and 19 family signs were also placed in position. This beautiful area is attracting added attention

from year to year, and is certainly destined to be one of great interest during the summer months, due not alone to its instructive features, but also to its natural charm.

Fruticetum.

Decided progress can also be recorded in the collection of shrubs. Many of the beds have been considerably enlarged to accommodate the growing representation of the respective families allotted to them, and some entirely new beds have been opened, these being required in several instances for families new to the collection. There are now in this area over 1,000 shrubs, about 350 of which were incorporated this year, illustrating 50 families, about 118 genera, and 455 species and varieties. Of these 3 families and 125 species and varieties are new to the collection. Two hundred and twenty-four show labels have been added here during the year.

Arboretum.

Some planting has been done here, especially in the line of willows and poplars in the southern end of the tract. Any great development in this tract, however, must await the completion of roads and paths, as their construction after the planting of trees is most disastrous, this fact being fully demonstrated for the past few weeks during the course of road-making in progress on portions of the arboretum site where young trees had been set out, these in many cases being much damaged by the unavoidable carting and hauling. Much material is being accumulated in the nurseries and borders, however, in preparation for active operations as soon as circumstances will permit. A large number of species of both deciduous and evergreen trees are making very satisfactory progress in the nursery plantations.

The tree label, upon which a report was submitted last year, still proves satisfactory. Many of them have now been exposed to the inclemencies of our variable climate for over 15 months, no repairs whatever having been made to them in the mean time, and I am glad to report that they are standing the test admirably.

Viticetum.

A number of species new to the collection have been added here, and the available space for many of the families is exhausted. It will be necessary to provide additional arbor room to properly accommodate more material.

Nurseries and Borders.

The material collected for several years in the area designated as the west nursery was in great part removed during the past fall, much of it being transplanted to the borders and extending their area to a considerable degree. Other portions were transferred to the new nursery, a continuation of what was formerly called the east nursery, and which is still retained. As stated above, there are many species of trees here which will soon be in a condition to transplant, and these will largely add to the interest and value of the arboretum, both deciduous and evergreen.

The nurseries and borders are divided into sections which are consecutively numbered. The plants in these sections, and their section number, are being recorded as fast as possible, so that it will soon be possible to locate definitely any plant desired.

Respectfully submitted,

GEO. V. NASH,

Curator of the Plantations.

REPORT OF THE HEAD GARDENER.

To the Director-in-Chief.

Sir: I have the honor to present to you the following report as Head Gardener for the past year. The work accomplished will be a memorable one in the history of the Garden. In the first place, the main front and part of the lateral range of the horticultural buildings have been completed, and, to the astonishment of ourselves and the public, are already pretty well filled with plants, nearly all donations.

Many of these were given because their owners could no longer accommodate them, having grown too large for private greenhouses; others have been presented out of pure love to do something for the benefit of the Garden, and the appreciation is shown by the great number of visitors availing themselves of the opportunity of seeing the progress of the development here. Interest is particularly shown in the naming of all the plants, their arrangement, classification, native habitats and family relations, this being entirely different from the indiscriminate staging of plants in an ordinary greenhouse arranged for display only.

The propagating houses are also about finished, as far as the present contract calls for; these will be used for the sowing of seeds, and growing of all young plants that may be collected in future, preparatory to planting in the near-by nurseries, or for the furnishing of permanent plants for the large horticultural houses; this will leave the main range for its legitimate use, that is, only specimen plants will be grown, and not too many of one species. It is proposed also to devote a liberal space to the students for experimental purposes. The heating is by the hot water system, which will be operated in a large, convenient cellar, where there is ample room for the storage of coal, bulbs, roots, soil and other requisites. The potting shed is a model in its way, having more benches and other conveniences than many commercial places.

The work of draining, removing rocks, grading, road making, and preparing the ground for permanent lawns has been pushed along as rapidly as the available labor force would permit.

Two of the main lawns have been graded and sown; these are already beginning to have a permanent look, having been cut with the scythe and lawn-mower several times.

The terraces on the southeast and southwest of the Museum Building are finished and greatly improve the approach to the two wings.

The paths running nearly parallel to the main driving road are well under way, and the coming spring will make them available for the use of the public.

The rounded grass terrace east of the main drive leading from the Boulevard was sodded just before frost; at the foot of this there is a grass gutter to carry the water to a catch basin at the foot of the hill, this doing its work admirably during a recent heavy rain as soon as finished.

The border north and south of the new station on the Harlem Railroad has been remodeled, the two loops lengthened and made to correspond with the wide approach from the station on entering the grounds.

Quite a quantity of shrubs have been planted in the way of groups on the main lawns.

Rhododendrons and azaleas were planted on the precipitous slopes south of the upper lake last spring. If these prove a success, it is intended to plant the whole of the slope in future with this class of plants. The expectation is that the shade of the deciduous trees growing naturally and the northern aspect will afford conditions favorable to their welfare; so far they have grown better than we expected.

The two former swamps are being transformed into lakes, by building a dam at the lower end near the Bronx River; the difference in level of the lakes will be about two feet. A permanent road is being built between them. The two varieties of yews planted on the ridge northwest of the herbaceous grounds, have flourished beyond expectation. A

new border between the power house and the southern boundary has been plowed, and planted with trees and shrubs. All of the trees, shrubs and herbaceous beds have had a coating of rotted manure; also the lawns.

The long rose bed that will form one of the boundaries of the future Mosholn Parkway approach has been a great success, although planted late last spring. Quite a number of tender, and monthly roses were planted along with the hybrid perpetuals. These have all been very carefully mulched to ensure their living through the winter.

Respectfully submitted,

SAMUEL HENSHAW,

Head Gardener.

SCHEDULE OF EXPENDITURES DURING 1900 UNDER APPROPRIATIONS MADE BY THE BOARD OF MANAGERS.

City Maintenance Account,.................................$40,000.00

Salaries and Labor.

Appropriated	33,645.23	
Expended	33,645.23	

Supplies and Repairs.

Appropriated	6,354.77	
Expended	6,354.73	
Total Expended		39,999.96
Balance		.04

Garden Accounts.

Equipment of the Laboratories.

Appropriated		2,000.00
Expended		1,999.71
Balance		.29

Museum and Herbarium Material.

Appropriated	3,750.00	
Transferred from Circulars Inviting Membership	11.00	
Transferred from Operation of Temporary Greenhouse	26.75	3,787.75
Expended	3,586.96	
Transferred to Grading Water Supply and Drainage	200.00	3,786.96
Balance		.79

Library.

Appropriated	1,400.00	
Transferred from Lectures	18.69	1,418.69
Expended		1,418.03
Balance		.66

Publications.

Appropriated	1,975.00	
Transferred from Circulars Inviting membership	83.41	
Transferred from Rent of Temporary Office	35.00	2,093.41
Expended		2,093.29
Balance		.12

Exploration and Collection.

Appropriated		$1,000.00
Expended		991.86
Balance		8.14

Lectures.

Appropriated		850.00
Expended	831.31	
Transferred to Library	18.69	850.00

Contingent Fund.

Appropriated		1,650.00
Expended		1,649.91
Balance		.09

Purchase of Plants.

Appropriated		1,200.00
Expended	977.81	
Transferred to Grading Water Supply and Drainage	200.00	1,177.81
Balance		22.19

Engineering Advice.

Appropriated		200.00
Expended		196.75
Balance		3.25

Special Assistance.

Appropriated		950.00
Expended		944.10
Balance		5.90

Circulars Inviting Membership.

Appropriated		625.00
Expended	530.59	
Transferred to Publications	83.41	
Transferred to Museum and Herbarium Material	11.00	625.00

Operation of Temporary Greenhouse.

Appropriated		200.00
Expended	173.25	
Transferred to Museum and Herbarium Material	26.75	200.00

Telephone Cable.

Appropriated		147.20
Expended		147.20

Meteorological Equipment.

Appropriated		140.00
Expended		140.00

Rent of Temporary Office.

Appropriated		140.00
Expended	105.00	
Transferred to Publications	35.00	140.00

Equipment of Stable.

Appropriated		300.00
Expended		297.28
Balance		2.72

Insurance.

Appropriated		425.00
Expended		418.20
Balance		6.80

Grading, Water Supply and Drainage.

Appropriated	5,750.00	
Transferred from Museum and Herbarium Material	200.00	

Transferred from Purchase of Plants........	200.00	6,150.00
Expended..................................		6,143.95
Balance...............................		6.05

Telephone Construction.

Appropriated	100.00
Expended	100.00

Model of Fountain.

Appropriated	200.00
Expended	200.00
Total appropriated for Garden Accounts.....	23,002.20
Total expended for Garden Accounts.........	22,945.20
Balance	57.00

SPECIAL GARDEN ACCOUNTS.

Ellis Fund.

Balance from 1899...............................	940.00
Expended	940.00

Microscope Fund.

Subscribed by Mr. William E. Dodge.......	665.50
Expended	665.50

Conservatory Fund.

Subscribed..	2,135.00
Expended..	710.44
Balance..............................	1,324.56

Special Book Fund.

Subscribed 1899.................................		4,950.00
Expended 1899	1,916.65	
Expended 1900	2,395.28	4,311.93
Balance		638.07

Total expenditures from funds of the Garden........................	$27,656.42

REPORT OF THE SCIENTIFIC DIRECTORS.

(Presented and accepted January 14, 1901.)

To the Board of Managers,
New York Botanical Garden.

Gentlemen: I have the honor to submit herewith the report of the Board of Scientific Directors for the year now closing.

The Scientific Directors have held two meetings. At the meeting of April 9, 1900, Dr. Henry H. Rusby was elected a Scientific Director, subject to confirmation by the Board of Managers. This confirmation was subsequently given.

Plans were approved for quite extended botanical exploration and investigation by various attachés of the Garden during the summer of 1900, which plans have been since carried out. In this way important work has been done along the Atlantic coast and in Bermuda by Dr. Marshall A. Howe; in Wyoming by Dr. Carlton C. Curtis; in northern Idaho by Dr. D. T. MacDougal; on the shores of the Gulf of Mexico and in the Mississippi Delta by Professor Francis E. Lloyd, and in southeastern Colorado by Dr. P. A. Rydberg.

Mr. Cornelius Van Brunt was appointed Honorary Floral Photographer to the Garden, and provision was made for vacations for the officers of the Garden.

The second meeting was held November 21, 1900. In the meantime Dr. Britton, the Director-in-Chief, had visited the Paris Exposition and had attended various botanical convocations as a representative of the Garden. In connection with his trip both at Paris and at other botanical centres in Europe, Dr. Britton succeeded in procuring a great quantity of scientific material for our collections, a detailed report regarding which was submitted to the Board of Scientific Directors at this meeting.

In general, regarding the work of the year, I may state that the courses of instruction have been firmly established and have drawn a body of students numbering about twenty

at the present time. It is gratifying to note that they come from various institutions, Columbia University being represented by only about one quarter of the number. The greenhouses have been installed and creditably filled with plants by means of gifts and subscriptions. The portions of the Garden devoted to herbs and shrubs have made very gratifying progress and now present most important opportunities for study and instruction. The same is true of the arboretum. The scientific work of the Garden, both as regards instruction and investigation, has now been successfully inaugurated and is in the full discharge of those activities for which it was created.

Respectfully,

SETH LOW,
Chairman.

REPORT OF THE COMMITTEE ON PATRONS, FELLOWS AND MEMBERS.

(Presented and Accepted January 14, 1901.)

To the Board of Managers of the New York Botanical Garden.

Gentlemen:

The number of new annual members who have qualified during the past year is 160.

The total number of annual members is now 837.

Of these 25 are in arrears for dues for 1900; 4 are in arrears for dues for 1899 and 1900; 4 are in arrears for dues for 1898, 1899 and 1900, and 2 are in arrears for dues for 1897, 1898, 1899 and 1900.

Annual dues have been collected to the amount of $8,160, which has been transmitted to the Treasurer as received.

Seventeen persons have qualified as life members by the payment of $100 each. These sums have been transmitted to the Treasurer for credit to the Endowment Fund.

A complete list of Patrons, Fellows, Life Members and Annual Members to date is herewith submitted.

New York, January 14, 1901.

Patrons.

Hon. Addison Brown,
Andrew Carnegie,
Columbia College,
*James M. Constable,
*Hon. Chas. P. Daly,
Wm. E. Dodge,
Geo. J. Gould,
Helen M. Gould,
Mrs. Esther Herrman,
John S. Kennedy,
D. O. Mills,
J. Pierpont Morgan,
*Oswald Ottendorfer,
James R. Pitcher,
John D. Rockefeller,
William Rockefeller,
Wm. C. Schermerhorn,
Jas. A. Scrymser,
Samuel Sloan,
*Cornelius Vanderbilt,
Mrs. Antoinette Eno Wood,

*Deceased.

Fellows.

Mrs. Melissa P. Dodge,
*C. P. Huntington,
David B. Ivison,
Morris K. Jesup,
John Innes Kane,
Hon. Seth Low,
*F. F. Thompson,
Samuel Thorne,
Tiffany & Co.,
H. C. von Post.

Life Members.

Edward D. Adams,
Mrs. James Herman Aldrich,
Richard H. Allen,
Samuel P. Avery,
Samuel D. Babcock,
George V. N. Baldwin,
Dr. John Hendley Barnhart,
Samuel R. Betts,
Geo. C. Boldt,
Geo. S. Bowdoin,
*Frederic Bronson,
E. Dwight Church,
Geo. C. Clarke,
Banyer Clarkson,
Mrs. Wm. Combe,
Theodore Cooper,
Melville C. Day,
Miss Julia L. Delafield,
Maturin L. Delafield, Jr.
Miss Ethel Dubois,
Miss Katharine DuBois,
Wm. A. DuBois,
Mrs. John Dwight,
Newbold Edgar,
George Ehret,
David L. Einstein,
Ambrose K. Ely,
Amos F. Eno,
Edward J. Farrell,
Andrew Fletcher,
Chas. R. Flint,
Col. Dr. Lancey Floyd-Jones,
James B. Ford,
Mrs. Theodore Kane Gibbs,
James J. Goodwin,
J. B. M. Grosvenor,
Bernard G. Gunther,
Frederic R. Halsey,
H. O. Havemeyer,
Very Rev. E. A. Hoffman,
Geo. B. Hopkins,
Archer M. Huntington,
Frank D. Hurtt,
Adrian Iselin,
Theo. F. Jackson,
Dr. E. G. Janeway,
Miss Annie B. Jennings,
Walter R. T. Jones,
W. B. Kunhardt,
Eugene Kelly, Jr.,
Mrs. George Lewis,
W. H. Lewis, Jr.,
Joseph Loth,
David Lydig,
Wm. H. Macy, Jr.,
Edgar L. Marston,
A. G. Mills,
Roland G. Mitchell,
John G. Moore,
A. Lanfear Norrie,

* Deceased.

Gordon Norrie,
Geo. M. Olcott,
Geo. Foster Peabody,
James Tolman Pyle,
M. Taylor Pyne,
Geo. W. Quintard,
Jacob Monroe Rich,
H. H. Rogers,
Reginald H. Sayer,
Edward C. Schaefer,
Mrs. I. Blair Scribner,
Isaac N. Seligman,
Francis L. Stetson,
Anson Phelps Stokes,
Miss C. Phelps Stokes,
Miss Olivia E. Phelps Stokes,
Charles G. Thompson,
Robert M. Thompson,
Wm. Stewart Tod,
Spencer Trask,
Miss Susan Travers,
F. T. Van Beuren,
Dr. Henry Freeman Walker,
F. N. Warburg,
John I. Waterbury,
John D. Wing.

Annual Members.

Dr. Robert M. Abbe,
Ernest Kempton Adams,
A. G. Agnew,
Mrs. Cornelius R. Agnew,
Miss Elizabeth Agnew,
R. Percy Alden,
John E. Alexandre,
C. L. Allen,
Dr. Timothy F. Allen,
William C. Alpers,
Bernard G. Amend,
John A. Amundson,
J. M. Andreini,
J. Sherlock Andrews,
John D. Archbold,
James Armstrong,
Dr. Edmund S. F. Arnold,
Francis B. Arnold,
Reginald H. Arnold,
John Aspinwall,
Theo. Aub,
Mrs. H. D. Auchincloss,
Hugh D. Auchincloss,
John W. Auchincloss,
George C. Austin,
Samuel P. Avery, Jr.
Mrs. Elizabeth Bache.
Mrs. N. P. Bailey,
Frederic Baker,
Stephen Baker,
Robert F. Ballantine,
Ewald Balthasar,
Amzi Lorenzo Barber,
Henry I. Barbey,
Wm. D. Barbour,
Henry H. Barnard,
E. W. Barnes,
John S. Barnes,
Chas. T. Barney,
William Barr,
E. W. Bass,
Chas. Batchelor,
Thos. H. Bauchle,
Alfred N. Beadleston,
Chas. C. Beaman,
Gerard Beekman,
M. H. Beers,
August Belmont,
James H. Benedict,
M. W. Benjamin,

Jno. R. Bennett,
Frank Sherman Benson,
Mrs. Adolph Bernheimer,
Chas. L. Bernheimer,
Simon E. Bernheimer,
Edward J. Berwind,
Henry Beste,
Albert S. Bickmore,
Eugene P. Bicknell,
L. Horatio Biglow,
Isaac Bijur,
Miss Elizabeth Billings,
Miss Laura Billings,
W. H. Birchall,
Geo. Blagden,
Mrs. Birdseye Blakeman,
Mrs. S. A. Blatchford,
Geo. T. Bliss,
Mrs. Wm. T. Blodgett,
Jno. H. Bloodgood,
Lyman G. Bloomingdale,
Mrs. Edward C. Bodman,
Henry W. Boettger,
Albert G. Bogert,
Frank S. Bond,
G. T. Bonner,
Hon. H. W. Bookstaver,
Simon Borg,
John M. Bowers,
J. Bramwell,
Michael Brennan,
M. P. Breslin,
Miss Cornelia G. Brett,
Mrs. Benjamin Brewster,
Marvin Briggs,
Chas. Astor Bristed,
Jno. I. D. Bristol,
W. T. Brittain,
Mrs. Harriet Lord Britton,
Mrs. Kate M. Brookfield,
John Crosby Brown,
M. Bayard Brown,
Robert I. Brown,
W. L. Brown,
W. P. Brown,
F. W. Bruggerhof,
H. B. Brundrett,
Mrs. William Bryce,
William Bryce, Jr.,
W. Buchanan,
Albert Buchman,
James Buckhout,
Mrs. J. Bunzl,
Wm. Allen Butler,
Dr. John Cabot,
John L. Cadwalader,
Albert Calman,
Emil Claman,
Henry L. Calman,
W. L. Cameron,
H. H. Cammann,
Henry L. Cammann,
S. T. Cannon,
G. M. Carnochan,
Mrs. Miles B. Carpenter,
James C. Carter,
Walter S. Carter,
John W. Castree,
John H. Caswell,
Dr. W. H. Caswell,
Frank R. Chambers,
Chester W. Chapin,
Geo. E. Chisolm,
Mrs. Wm. E. Chisolm,
Jared Chittenden,
Wm. G. Choate,
W. F. Chrystie,
Miss Helen L. Chubb,
John K. Cilley,
John Claflin,

J. Mitchell Clark,
Wm. N. Clark,
C. C. Clarke,
Frederick Clarkson,
Dr. Wm. J. Coates,
Wm. F. Cochran,
John W. Cochrane,
Miss Mary F. Cockcroft,
C. A. Coffin,
Chas. H. Coffin,
Edmund Coffin,
E. W. Coggeshall,
Samuel M. Cohen,
N. A. Colburn,
Mrs. James B. Colgate,
P. F. Collier,
F. Collingwood,
Miss Ellen Collins,
Alexander T. Compton,
Roland R. Conklin,
Wm. L. Conyngham,
C. T. Cook,
Mrs. C. T. Cook,
Henry H. Cook,
Hon. Edward Cooper,
Geo. Coppell,
C. H. Coster,
Chas. J. Coulter,
Albert Crane,
Geo. F. Crane,
Jonathan H. Crane,
Mrs. Jonathan H. Crane,
Francis Crawford,
Robert L. Crawford,
H. G. Crickmore,
John D. Crimmins,
George A. Crocker,
Frederic Cromwell,
James W. Cromwell,
Edwin A. Cruikshank,
Charles Curie,
Charles B. Curtis,
Henry Dalley,
Ira Davenport,
William Gilbert Davies,
Clarence S. Day,
H. de Coppet,
Richard Deeves,
Robert W. DeForest,
Dr. C. Bryson Delavan,
Charles de Rham,
Theo. J. de Sabla,
Theo. L. DeVinne,
F. W. Devoe,
W. B. Dickerman,
Charles D. Dickey,
Mrs. Hugh T. Dickey,
George H. Diehl,
Charles F. Dieterich,
Miss Mary A. Dill,
Mrs. Henry F. Dimock,
Rev. Morgan Dix,
Cleveland H. Dodge,
D. Stuart Dodge,
George E. Dodge,
Miss Grace H. Dodge,
Mrs. William E. Dodge, Jr.,
C. W. Doherty,
L. F. Dommerich,
Mrs. Henry Dormitzer,
Henry Doscher,
J. R. Doudge,
Mrs. George William Douglass,
James Douglass,
Mrs. David Dows,
Mrs. David Dows, Jr.,
Tracy Dows,
John J. Drake,
B. Ferdinand Drakenfeld,
Mrs. Henry Draper,

Matthew B. Du Bois,
John Duer,
R. G. Dun,
John P. Duncan,
Dr. Edward K. Dunham,
George H. Dunham,
E. B. Dunne,
S. Whitney Dunscomb, Jr.,
Frank J. Dupignac,
H. A. Du Pont,
John S. Durand,
J. B. Dutcher,
Thomas Dwyer,
D. Edgar,
Miss Laura Jay Edwards,
Edward Ehrlich,
Henry G. Eilshemius,
August Eimer,
Mrs. Matilda A. Elder,
Geo. W. Ellis,
John W. Ellis,
J. M. Ellsworth,
Wm. Ellsworth,
Wm. W. Ellsworth,
John J. Emery,
C. Temple Emmet,
Robert Temple Emmet,
Robert Endicott,
Jno. C. Eno,
Louis Ettlinger,
Richard Evans,
H. C. Fahnestock,
Thos. H. Faile,
Samuel W. Fairchild,
Jas. C. Fargo,
Henry W. Farnam,
William L. Findley,
B. Fischer,
Mrs. Josiah M. Fiske,
Stephen Fiske,
Mrs. Louis Fitzgerald,
Wm. L. Flanagan,
Isaac D. Fletcher,
Miss Helena Flint,
A. R. Flower,
J. D. Flower,
Edw. W. Foster,
Scott Foster,
Mrs. A. Frankfield,
H. P. Frothingham,
Wm. F. Gade,
John A. Garver,
Joseph E. Gay,
Mrs. Martha F. Gay,
William H. Gebhard,
S. J. Geoghegan,
John J. Gibbons,
Mrs. Hervey de Blois Gibson,
R. W. Gibson,
George Gill,
J. Waldron Gillespie,
Peter C. Gillings,
Georges A. Glaenzer,
Frederic N. Goddard,
Chas. H. Godfrey,
Mrs. Edwin L. Godkin,
Samuel Goodman,
E. Read Goodridge,
Mrs. Frederic Goodridge,
Francis Goodwin,
Miss Theodora Gordon,
Edwin Gould,
Hon. Wm. R. Grace,
Robert D. Graham,
Henry Graves,
John Clinton Gray,
Ernest F. Greeff,
John Greenough,
Isaac J. Greenwood,
Rev. David H. Greer,

Daniel J. Griffith,
E. Morgan Grinnell,
Chester Griswold,
W. C. Gulliver,
W. S. Gurnee,
W. S. Gurnee, Jr.,
John A. Hadden,
John A. Hadden, Jr.,
J. and M. Haffen,
James D. Hague,
Miss Laura P. Halsted,
Wm. Hamann,
Miss Adelaide Hamilton,
Chas. T. Harbeck,
J. Montgomery Hare,
E. H. Harriman,
S. W. Harriot,
Wm. Hamilton Harris,
Mrs. William Hamilton Harris,
Marcellus Hartley,
Jacob Hasslacher,
Miss Mary R. Hatch,
Dr. Louis Haupt,
J. C. Havemeyer,
T. A. Havemeyer,
G. G. Haven,
J. Woodward Haven,
R. Somers Hayes,
Frederick W. Haynes,
Arthur H. Hearn,
William W. Heaton,
John G. Heckscher,
L. A. Heinsheimer,
Homer Heminway,
Chas. R. Henderson,
Chas. Henderson & Son,
Jos. J. Henderson,
Edmund Hendricks,
Samuel Henshaw,
Hon. Abram S. Hewitt,
James J. Higginson,
Geo. R. Hill,
Wm. K. Hinman,
Dr. John H. Hinton,
B. Hochschild,
Dr. Abbott Hodgman,
Mrs. Robert Hoe,
Mrs. George Hoffman,
John Swift Holbrook,
E. B. Holden,
E. R. Holden,
Miss Virginia Hollins,
Henry Holt,
Isaac A. Hopper,
William W. Hoppin,
Burrett W. Horton,
Dr. Lucius W. How,
William P. Howe,
Alfred M. Hoyt,
Gerald L. Hoyt,
Samuel N. Hoyt,
Gen. Thomas H. Hubbard,
John E. Hudson,
Alex C. Humphreys,
Dr. Frederick Humphreys,
Edward T. Hunt,
* C. P. Huntington,
Mrs. Robert P. Huntington,
Adolph G. Hupfel,
Frank Hustace,
John S. Huyler,
Clarence M. Hyde,
Frederick E. Hyde, Jr.,
Henry Iden, Jr.,
Mrs. Samuel Inslee,
John B. Ireland,
A. D. Irving,
Adrian Iselin, Jr.,

* Deceased.

Miss Georgine Iselin,
William E. Iselin,
Samuel Isham,
William B. Isham,
Charles Carroll Jackson,
Frederic Wendell Jackson,
Dr. Abram Jacobi,
Robert Jaffray,
A. C. James,
D. Willis James,
Dr. Robert C. James,
Samuel M. Jarvis,
O. G. Jennings,
Walter Jennings,
James R. Jesup,
Geo. Pryor Johnson,
Adrian H. Joline,
Mrs. John D. Jones,
S. Nicholson Kane,
Mrs. H. F. Kean,
Mrs. A. B. Kellogg,
Mrs. Chas. Kellogg,
Thos. H. Kelly,
Edward Kemp,
Prof. J. F. Kemp,
H. Van Rensselaer Kennedy,
Mrs. Elizabeth C. Kenyon,
Rudolph Keppler,
Mrs. Catherine L. Kernochan,
John B. Kerr,
Geo. A. Kessler,
A. P. Ketchum,
Wm. Kevan,
Samuel K. Keyser,
Nathaniel T. Kidder,
Alfred R. Kimball,
David H. King, Jr.,
William F. King,
William M. Kingsland,
Gustave E. Kissel,
Herman Knapp,
Shepherd Knapp,
Percival Knauth,
Henry C. F. Koch,
Chas. Kohlman,
Wm. Krafft,
Julius G. Kugelman,
Percival Kühne,
H. R. Kunhardt, Jr.,
Adolf Kuttroff,
William M. Laffan,
Francis G. Landon,
Woodbury Langdon,
J. D. Lange,
Lewis H. Lapham,
Jesse Larrabee,
Richard Lathers,
Walter W. Law,
John Burling Lawrence,
Mrs. Lydia G. Lawrence,
Richard H. Lawrence,
Mrs. Samuel Lawrence,
W. V. Lawrence,
J. D. Layng,
Prof. Frederic S. Lee,
Wm. H. Lefferts,
Emanuel Lehman,
Edward A. Le Roy, Jr.,
Arthur L. Lesher,
Julius Levine,
Mrs. John V. B. Lewis,
Leonard Lewisohn,
Philip Lewisohn,
Wm. S. Livingston,
Wm. C. Lobenstine,
Luke A. Lockwood,
James Loeb,
Prof. Morris Loeb,
Walter S. Logan,
Mrs. Daniel D. Lord,

Franklin B. Lord,
R. P. Lounsbery,
C. Adolphe Low,
Mrs. Charles Russell Lowell,
Charles H. Ludington,
August Lueder,
Walther Luttgen,
Samuel H. Lyman,
Mrs. Alida McAlan,
C. W. McAlpin,
Geo. L. McAlpin,
John A. McCall,
J. Jennings McComb,
Mrs. W. H. McCord,
Thos. A. McIntyre,
Mrs. Jeannie McKewan,
Gilbert H. McKibbin,
Rev. Haslett McKim,
George William McLanahan,
James McLean,
George R. MacDougall,
W. W. MacFarland,
J. W. Mack,
D. E. Mackenzie,
Malcolm MacMartin,
Charles A. Macy, Jr.,
Charles A. Macy, 2d,
V. Everit Macy,
J. H. Maghee,
Alexander Maitland,
Charles Mallory,
Howard Mansfield,
Miss Delia W. Marble,
Theophilus M. Marc,
A. Marcus,
Peter Marie,
Jacob Mark,
T. M. Markoe,
Henry S. Marlor,
Henry G. Marquand,
Charles M. Marsh,
Charles H. Marshall,
Louis Marshall,
Edwin S. Marston,
W. R. H. Martin,
Brander Matthews,
Robert Maxwell,
David Mayer,
Henry Mayer,
Harry Mayer,
Mrs. Emma Mehler,
Payson Merrill,
Captain Henry Metcalfe,
Dr. Alfred Meyer,
J. Meyer,
Thomas C. Meyer,
Dr. George N. Miller,
Jacob F. Miller,
S. M. Milliken,
W. McMaster Mills,
Peter Moller,
John Monks,
A. C. Monson,
Alphonse Montant,
Francis C. Moore,
Wm. H. Helme Moore,
Mrs. Daniel Moran,
E. D. Morgan,
Geo. H. Morgan,
A. H. Morris,
A. Newbold Morris,
Miss Cora Morris,
Henry Lewis Morris,
Lewis R. Morris,
Geo. Austin Morrison,
Richard Mortimer,
H. O. Moss,
Ed. M. Muller,
Robt. I. Murray,
Isaac Myer,

Nath'l Myers,
Adam Neidlinger,
Edward M. Neill,
Wm. Nelson,
Geo. G. Nevers,
Miss Catherine A. Newbold,
Miss Edith Newbold,
Frederic R. Newbold,
Geo. L. Nichols,
John Barron Niles,
Wm. Nilsson,
John Notman,
Frederick J. Nott,
Adolph Obrig,
E. E. Olcott,
Mrs. Chas. Tyler Olmsted,
Robert Olyphant,
Mrs. Emerson Opdycke,
Wm. S. Opdyke,
Adolphe Openhym,
Mrs. Wm. Openhym,
William C. Orr,
Prof. Henry S. Osborn,
Wm. Church Osborn,
Mrs. W. H. Osborn,
Mrs. Thomas J. Owen,
Lowell M. Palmer,
N. F. Palmer,
S. S. Palmer,
Henry Parish,
Henry Parish, Jr.,
John H. Parker,
Henry V. Parsell,
Mrs. Phebe A. Parshall,
Charles Parsons,
Mrs. Edwin Parsons,
John E. Parsons,
W. A. Paton,
O. H. Payne,
Mrs. Frederick Pearson,
Alfred Pell,
Miss Frances Pell,
Wm. Hall Penfold,
Geo. H. Penniman
Geo. W. Perkins,
Samuel T. Peters,
W. R. Peters,
Franklin Phillips,
Lloyd Phoenix,
Phillips Phoenix,
Winslow S. Pierce,
Gottfried Piel,
Gifford Pinchot,
James W. Pinchot,
Fred. S. Pinkus,
Hon. Thos. C. Platt,
Gilbert M. Plympton,
Henry W. Poor,
A. S. Post,
C. A. Postley,
Frederick Potts,
De Veaux Powel,
Joseph M. Pray,
Anderson Price,
Prof. J. Dyneley Prince,
Chas. Pryer,
Percy R. Pyne,
Charles Raht,
Gustav Ramsperger,
George Curtis Rand,
Rastus S. Ransom,
Geo. R. Read,
Wm. A. Read,
G. H. Redmond,
Whitelaw Reid,
Geo. N. Reinhardt,
John B. Reynolds,
Miss Serena Rhinelander,
John Harsen Rhoades,
Prof. Charles Rice,

Auguste Richard,
Prof. P. de P. Ricketts,
John L. Riker,
Samuel Riker,
Dr. Wm. C. Rives,
S. H. Robbins,
Miss Mary M. Roberts,
Andrew J. Robinson,
Frederick Rode,
J. C. Rodgers,
Edward L. Rogers,
Noah C. Rogers,
Theo. Rogers,
W. Emlen Roosevelt,
Mrs. W. Emlen Roosevelt,
Hon. Elihu Root,
Leo. Rosett,
E. V. W. Rossiter,
Jacob Rothschild,
Wm. Rothschild,
Geo. P. Rowell,
Charles Runyon,
Jacob Ruppert,
Mrs. A. D. Russell,
Chas. Howland Russell,
Clarence Sackett,
Henry W. Sackett,
Mrs. Edward C. Sampson,
C. Daniel Sands,
L. F. Saumenicht,
Robt. W. Schedler,
Carl Schefer,
Miss Mary E. Schell,
J. Egmont Schermerhorn,
Mrs. H. M. Schieffelin,
Dr. Wm. Jay Schieffelin,
Jacob H. Schiff,
Gustave Schirmer,
Grant B. Schley,
Miss Jane E. Schmelzel,
Henry W. Schmidt,
Paul G. Schoeder,
C. Schumacher,
Philip Schuyler,
L. Henry Schwab,
Adolph Schwarzmann,
Mrs. James Scott,
Edward M. Scudder,
Geo. J. Seabury,
Wm. F. Sebert,
Mrs. Horace See,
Geo. W. Seligman,
Isaac N. Seligman,
T. G. Sellew,
Prof. Fred. Seringhaus,
Alfred Seton, Jr.
Mrs. Clarence Seward,
Mrs. Angelica B. Shea,
W. H. Sheehy,
Edward M. Shepard,
G. K. Sheridan,
Gardiner Sherman,
G. O. Shields,
Robt. Simon,
John Boulton Simpson,
John W. Simpson,
W. T. Simpson,
John Sinclair,
Samuel T. Skidmore,
Francis Louis Slade,
Chas. F. Smillie,
James D. Smillie,
Mrs. Annie Morrill Smith,
Chas. Robinson Smith,
Edward A. Smith,
George W. Smith,
James H. Smith,
James R. Smith,
John Jewell Smith,
Walter M. Smith,

Wm. Alex. Smith,
Hans Sommerhoff,
Chas. Sooysmith,
A. W. Soper,
Frederick Southack,
Samuel Spencer,
Paul N. Spofford,
Miss Anna Riker Spring,
Dr. Edward Hamilton Squibb,
J. R. Stanton,
John Stanton,
Jno. N. Stearns,
James H. Stebbins,
Henry Steers,
James R. Steers,
Olin J. Stephens,
Benjamin Stern,
Isaac Stern,
Louis Stern,
Alexander H. Stevens,
Dr. Geo. T. Stevens,
Lispenard Stewart,
Wm. R. Stewart,
Jos. Stickney,
Miss Clara F. Stillman,
Dr. D. M. Stimson,
James Stokes,
Mrs. J. O. Stone,
Mason A. Stone,
Sumner R. Stone,
Chas. Strauss,
Edward Sturges,
F. K. Sturgis,
Thos. Sturgis,
Rutherford Stuyvesant,
Mrs. Geo. Such,
Miss Catharine Allen Sullivan,
John S. Sutphen,
Mrs. P. C. Swords,
Albert Tag,
Edward N. Tailer,
C. A. Tatum,
Miss Alexandrina Taylor,
Geo. C. Taylor,
Stevenson Taylor,
Wm. E. Tefft,
C. H. Tenney,
H. L. Terrell,
Jno. T. Terry,
Nikola Tesla,
Ernest Thalmann,
Anthony J. Thomas,
Samuel Thomas,
L. S. Thompson,
Walter Thompson,
Dr. W. Gilman Thompson,
Miss Phebe Anna Thorne,
W. V. S. Thorne,
William Thorne,
H. L. Thornell,
C. C. Tiffany,
C. L. Tiffany,
Louis C. Tiffany,
Albert Tilt,
E. Titus, Jr.,
J. Kennedy Tod,
William Toel,
Wm. Toothe,
Henry R. Towne,
R. H. L. Townsend,
R. W. Townsend,
C. D. Tows,
J. Evarts Tracy,
Edwin D. Trowbridge,
Frederick K. Trowbridge,
Dr. Alfred Tuckerman,
Paul Tuckerman,
Geo. E. Turnure,
Benjamin Tuska,
Edward P. Tysen,

E. S. Ullmann,
Miss Anna Murray Vail,
Herbert Valentine,
Mrs. Lawson Valentine,
Charles H. Van Brunt,
Cornelius Van Brunt,
E. H. Van Ingen,
Alfred Van Santvoord,
Joseph Van Vleck,
Edgar B. Van Winkle,
Miss Elizabeth S. Van Winkle,
H. A. Von Post,
George H. Vose,
John Wagner,
Hon. Salem H. Wales,
Dr. Henry F. Walker,
Lewis Wallace,
Antony Wallach,
William I. Walter,
E. A. Walton,
William T. Wardwell,
Allan C. Washington,
Miss Emily A. Watson,
S. D. Webb,
Mrs. John A. Weekes,
Charles Wehrhane,
Camille Weidenfeld,
Mrs. John Wells,
R. E. Westcott,
George Westinghouse,
Dr. John M. E. Wetmore,
Dr. George G. Wheelock,
Dr. William E. Wheelock,
A. H. White,
Horace White,
Stanford White,
Dr. Whitman V. White,
J. Henry Whitehouse,
Worthington Whitehouse,
James Whitely,
Giles Whiting,
Clarence Whitman,
William Wicke,
Edward A. Wickes,
Franklin A. Wilcox,
Robert F. Wilkinson,
David Willcox,
John T. Willets,
Robert R. Willets,
G. G. Williams,
Richard H. Williams,
Mrs. Douw D. Williamson,
Washington Wilson,
William G. Wilson,
Dr. Joseph E. Winters,
Edgerton Winthrop,
Grenville L. Winthrop,
Mrs. Frank S. Witherbee,
Ernst G. W. Woerz,
I. B. Wolfe,
A. Wolff,
Emil Wolff,
Lewis S. Wolff,
Mrs. Cynthia A. Wood,
William Congdon Wood,
John A. Woods,
F. F. Woodward,
Professor R. S. Woodward,
W. H. Woolverton,
Henry H. Wotherspoon,
Miss Julia Wray,
Mrs. J. Hood Wright,
C. S. Young,
Edward L. Young,
Andrew C. Zabriskie,
August Zinsser,
O. F. Zollikoffer.

REPORT OF THE TREASURER.

New York, January 14, 1901.

To the Board of Managers of
the New York Botanical Garden.

Gentlemen:

Herewith I submit a statement of my Receipts and Disbursements during the year 1900 and a Balance Sheet from my ledger as of December 31, 1900.

Respectfully yours,

C. F. Cox, *Treasurer.*

Receipts.

Balance of Cash brought over from 1899		$14,099.55
Fixed Income:		
3 per cent. on $110,000 N. Y. City Bonds	$3,300.00	
4 per cent. on $50,000, Erie R. R. Co. Prior Lien Bonds	2,000.00	
4½ per cent. on $50,000, Ches. & Ohio R. R. Co. Genl. Mtge. Bonds	2,250.00	
5 per cent. on $50,000, Southern Ry. Co. First Consol. Bonds,	2,500.00	10,050.00
Appropriations of the City for Maintenance		38,147.69
Annual Dues		8,180.00
Interest @ 3 per cent. allowed by J. P. Morgan & Co. on cash balance with them		274.04
Proceeds of Merchandise sold		28.30
Proceeds of Publications sold		168.95
Life Membership Fees		1,700.00
Tuition Fees—Credited to Students' Research Fund		543.50
Contributions to Conservatory Fund (for living plants)		2,110.00
Contribution from Mr. Wm. E. Dodge for purchase of Exhibition Microscopes.		665.50
		$75,967.53

Disbursements.

Addition to Director in Chief's Working Fund	$2,500.00	
Expenses paid through Director-in-Chief:		
Account City Maintenance	38,147.69	
On General Account	24,071.73	
Account Special Appropriation for specimens	393.89	
Books—Account Special Book Fund	2,279.61	
Plants—Account Conservatory Fund	492.07	
Exhibition Microscopes	665.50	68,550.49
Balance, Cash on hand		$ 7,417.04

LEDGER BALANCES, DECEMBER 31, 1900.

		Dr.	*Cr.*
Permanent funds:	Endowment Fund		$264,750.00
	Fellowship fees		8,000.00
	Life membership fees		8,600.00
	Students' Research Fund		724.00
			282,074.00
Temporary funds:	For Ellis collection		940.00
	For Library books		789.64
	For Conservatory plants		1,617.93
Investments:			
	Net cost of $110,000. N. Y. City Bonds; $50,000. Ches.& Ohio Ry.Co. Genl. Mtge. Bonds, $50,000. Southern Ry. Co. 1st Cons. Mtge. Bds; $50,000. Erie R. R. Co. Prior Lien Bonds		$258,248.76

Director in Chief, Working Fund........	7,500.00	
Construction Account, cost of plans not yet used.	2,350.00	
Income account, balance borrowed from Permanent Funds............................	9,905.77	
Cash in bank....................................	7,417.04	
	$285,421.57	$285,421.57

FEBRUARY 13, 1901.

CHARLES F. COX, Esq., *Treasurer*,

New York Botanical Garden, New York City.

My Dear Sir: As requested by you, I have caused your accounts, as Treasurer of the New York Botanical Garden, to be examined and audited for the year 1900, and take pleasure in reporting that the same have been found to be correct, in accordance with your balance sheet and statement of receipts and disbursements, returned herewith, as per the attached report.

Yours very truly,

JAMES A. SCRYMSER,

Chairman, Finance Committee.

BOTANICAL CONTRIBUTIONS.

Propagation of Lysimachia terrestris (L.) B.S.P.

By D. T. MacDougal.

In the course of some studies on etiolative reactions, the writer had occasion to make numerous cultures of *Lysimachia terrestris*, and the facts gained seemed to be of such general interest in their bearing upon the physiology of propagation as to be worthy of separate presentation.

This plant is an inhabitant of swampy meadows and moist thickets in eastern North America. The subterranean portion of the plant consists of a more or less sparingly branched rhizome. At the beginning of the season the terminal buds acquire apogeotropism and develop leafy, branching stems bearing a terminal virgate raceme of inconspicuous flowers. The slowly extending rhizomes accomplish some multiplication of the individuals by the dying away of the older portions leaving the younger detached branches as independent and new plants. The greatest amount of propagation, however, is accomplished by the bulbils.

Fig. 1. Apical portion of stem with bulbils.

The bulbils are formed in the axils of the leaves of the main aërial stems. These bodies are 4 to 15 mm. long with a diameter of 2 to 3 mm. in the middle, tapering slightly to the blunt basal end and sharply to the pointed apex. Their greatest diameter is about twice that of the main stem on which they are formed. These bulbils are generally branches of of the first order, though often found in the axils of these branches, and, as a natural consequence, the bulbils themselves are sometimes branched. The bulbil shows the three to five internodes of the normal branch, and the pair of short ovate scales arising from each node gives them the appearance of a loranthaceous

stem. In consequence, the plant was mistaken by Linnaeus for a terrestrial parasite and named by him *Viscum terrestre*.

During seasons with well distributed rainfall, and fairly equable temperature, such as that of 1900, the specimens growing in the open meadows in the New York Botanical Garden produced only a few small bulbils, and rather dense racemes of flowers followed by a full crop of seeds. If a

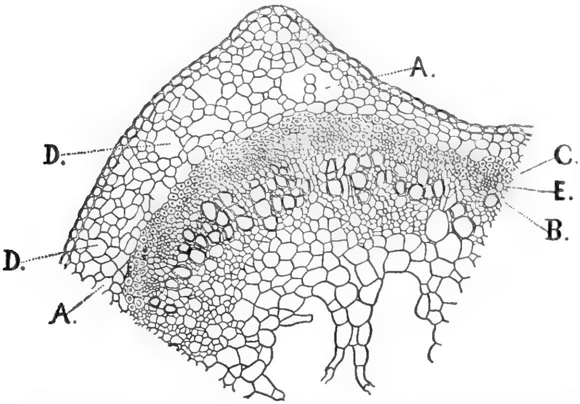

FIG. 3. Cross section of portion of branch of *Lysimachia terrestris*. *A*, intercellular spaces. *B*, xylem. *C*, sclerenchyma. *D*, glandular ducts. *E*, cambium.

drouth ensues during the early period of development of the flower bud and extension of the branches, however, the growth of the former is checked and the latter are converted into bulbils. In many instances all of the branches are converted into bulbils, which remain attached to the main stem after the leaves have withered and fallen off. This effect may be produced if the plant is grown in diffuse light or in greenhouses showing low night temperatures. An example of the latter is shown in Plate 13, Fig. B.

The bulbils remain attached to the stems until about the time of the autumnal leaf casting. After they fall to the ground their tapering outlines facilitates their descent in the upper layer of fallen leaves, and looser layer of soil so that a large number of them soon reach a position below danger from frost. This habit is slightly altered when they drop in

the water, where their buoyancy causes them to float until the approach of cold weather when they sink and escape freezing. Upon the approach of warm weather the formation of gases in the chlorophyl-bearing tissues causes them to rise and float about in such manner that many of them may be carried long distances before germination ensues. This appears to be the only method by which dissemination to any distance is secured.

The bulbils show a very weak power of resistance to low temperatures and to desiccation. Specimens taken from the soil and placed in a seed envelope in a laboratory at temperatures from 15 to 22°C. were shrivelled and incapable of growth a month later. Others laid on a table wholly unprotected were dead in four days.

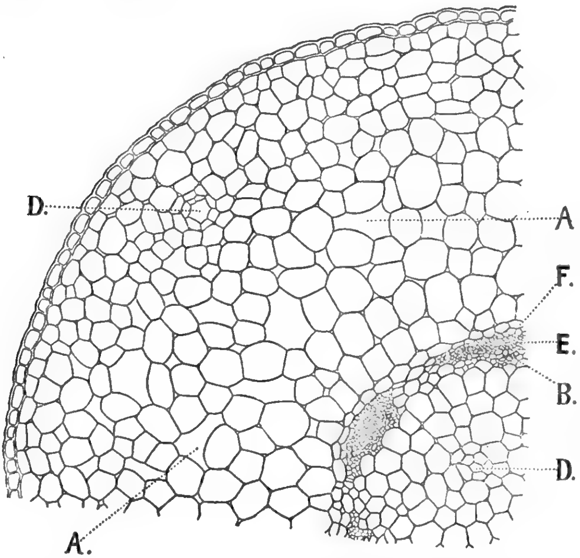

FIG. 4. Cross section of portion of bulbil of *Lysimachia terrestris*. *A*, intercellular spaces. *B*, protoxylem. *D*, glandular ducts. *E*, procambrium. *F*, sheath.

A temperature of a few degrees below the freezing point was sufficient to kill them, although a large proportion survived the winter when buried to a depth of a few centimeters in the soil.

The adaptation by which aërial branches are converted into

bulbils, or rather by which bulbils instead of branches are formed, seems to consist in a stoppage of the development of the stelar tissues and an exaggerated production of the cortex. This action makes the bulbils very similar to the rhizomes in general anatomy, and as may be seen later the bulbils actually pass into rhizomes when they continue their growth in the soil. The central pith has about the same bulk as that of the aërial stems ; the elements as well as those of the cortex are globose and furnished with large intercellular spaces. The protoxylem consists of a number of elongated elements of the customary type, and the protophloem is a thin ring of cambiform cells and companion cells, with a fairly well-marked sheath marking the inner boundary of the cortex. The cortical cells are arranged in radial plates after the manner

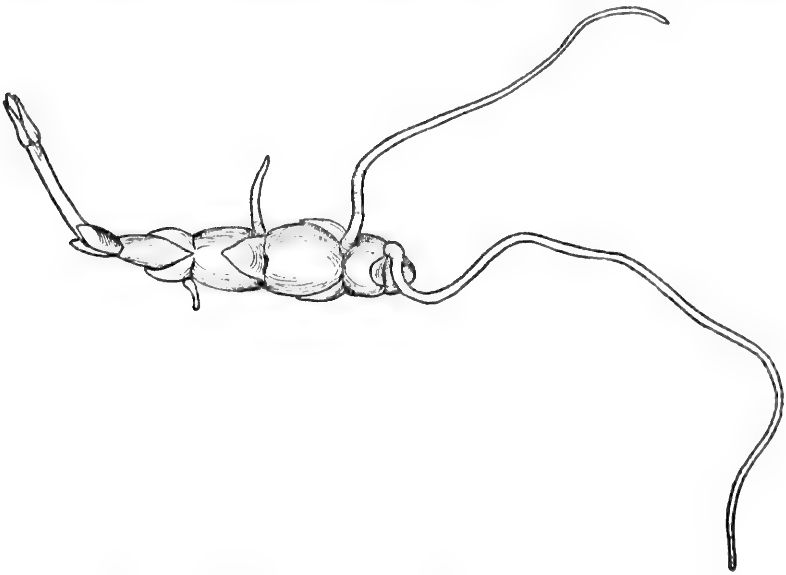

FIG. 5. Germinating bulbil, showing origin of roots. $\times$ 4.

of aquatic stems. An outer region of five or six layers has the elements more compactly arranged ; these contain starch and chlorophyl in abundance, and many of them in common with the epidermis include red coloring matter, and a granular substance the identity of which has not been ascertained.

Five or six glandular ducts may be seen in the cross section of the cortex in agreement with the rhizome while the aërial stems usually show but four. One or more of these ducts occur in the pith in both kinds of stems. Whether or not the secretion exercises a protective function has not been ascertained.

Perhaps the most marked structural adaptation of the bulbil is the entire absence of stomata or transpiratory openings in the epidermis, which is also true of the short bracts; the inner surfaces of the scales sheathing the terminal buds are furnished with capitate glandular hairs however.

As has been noted the bulbils are but sparsely provided with reserve food, and while they may remain quiescent throughout the winter in equable temperatures, yet they may be induced to germinate in a few days or a few weeks after separation from the parent plant. The first indication of activity consists of the formation of roots at the basal nodes, but these organs are formed from all of the internodes before the apical bud is fairly in action. Germination proceeds indifferently in water and soil. The bulbils have a specific gravity greater than water and usually sink when first separated from the plant but rise to the surface when germination begins, by reason of the gases accumulated, although they rise and sink erratically if allowed to continue growth in water.

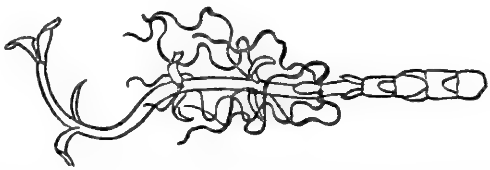

FIG. 6. Advanced stage in germination of bulbil in water, showing spiral form of roots, and geotropic curvature of shoot. $\times 2$.

The roots appear to be subject to the usual contraction of the cortex which takes place so irregularly, however, that these organs are thrown into spirals. The tangle produced by the twisted roots is most effective in causing a floating germinating bulbil, to become entangled in the branches or roots of

other aquatic plants. At the same time this contraction also serves to secure the anchorage of specimens which have lodged in the mud and penetrated it, and to draw the bulbil down into the loose soil when germination takes place on land.

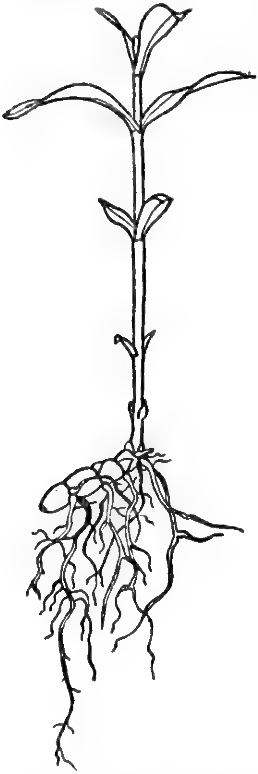

FIG. 7. Advanced stage of germination of bulbil which is being converted into a rhizome. Actual size.

The apical bud becomes apogeotropic soon after germination after the manner of a rhizome rather than of the branch, and its upward curvature disturbs the balance of a floating bulbil in such manner that it turns over with the result that the bud is directed downward. It is soon turned upward, however, by a reverse curvature and this process is repeated many times until anchorage is secured (Fig. 6).

The bulbil retains its general relations in polarity by forming roots from the basal end primarily and developing the apical bud most readily. Modifications amounting to direct reversal of these relations may be made by external conditions however. Any one of the growing points in the axils of the bracts may be forced to grow and develop the main axis of a new plant, or the bulbil may be cut into several portions, each of which may give rise to a new plant.

Perhaps the most interesting feature of the history of the bulbils is the fact that they do not perish in germination and in giving rise to a new individual. Bulbs and other modified stems generally consist of a mass of tissue which has reached its full development, while the power of extended growth is retained only by certain generative regions. New shoots are formed by the growth of these points and food for their nourishment is withdrawn from the storage tissues of the bulb which soon breaks down and does not participate further in the history of the new individuals.

The bulbils of *Lysimachia*, however, are simply slender stems in which elongation and differentiation has been checked at an early stage, and the entire stele remains in an embryonic condition. But little reserve food is accumulated. The separation of the bulbil from the parent plant, and the proper conditions of moisture and temperature act as stimulants which incite a renewed development of all of the regions of the organ. This results in the development of the xylem, phloem and cortex in such manner as to fit the bulbil for a life under the surface of the substratum, and for it to become the subterranean axis of a new plant, which perishes only by dying away slowly at the basal end after the manner of such structures. The sheathing scale leaves only appear to have attained full development during the stage of attachment to the parent plant. This continued existence of the bulbil of *Lysimachia* places it alone in a new category of propagative bodies.

The following statements may be made in conclusion:

Propagation of *Lysimachia terrestris* is effected by the branching and gradual death of the rhizomes, and by the growth of bulbils formed in the axils of the aërial stems.

The bulbils are branches of restricted development, of the first and second order, which are formed under various conditions unfavorable to the formation of seeds. Diffuse light and low temperatures seem to be the principal inciting causes, and these structures are formed in especial abundance in dry seasons.

The bulbils are free from transpiratory organs of any kind, and resemble rhizomes in structure rather than aërial stems on which they are borne.

Detached bulbils are killed by exposure to a freezing temperature in the open air, or by exposure to an atmosphere of a relative humidity of 30 to 40 per cent. for a day or two, at a temperature of 18–22° C.

The germination of the bulbil ensues without any appreciable resting period, and is followed by the final stages of the differentiation of the stele, which was checked during the

formation of the bulbil. The bulbil becomes the main axis of the new plant, and does not perish, except gradually, after the manner of a rhizome, into which it becomes converted. In this it forms a new type of vegetative reproductive body among the seed plants.*

The Mimosaceae of the southeastern United States.

By John K. Small.

A study of the published treatments of the Family Mimosaceae, especially in connection with work on the representatives of that family in the southeastern United States, has convinced me that they are all far too artificial and, to say the least, impracticable. An examination of the genera and species occurring in this region has led me to the conclusions expressed in the following synopsis. †

Family MIMOSACEAE Reichenb. Fl. Exc. 437. 1832.

The Mimosaceae differ from the Caesalpinaceae and the Papilionaceae, the other main divisions of the group Leguminosae in which the family formerly was included, chiefly by their regular flowers.

Key to the Genera.

Stamens numerous, more than 10.
 Filaments partially united into a tube.
  Valves of the pod not separating from the continuous margin.
   Pods with woody or thick-leathery valves.
    Leaves with 4 leaflets, or if more, few and relatively large: spikes head-like: ovary stipitate; pods contorted, with thick-leathery valves. 1. Pithecolobium.

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* See Vöchting, H., Zur Physiologie der Knollengewächse. Jahrb. f. Wiss. Bot. 34: 1899.

See Beal, W. J., Seed dispersal, p. 21, 1898, for notes on bulbils of other species of *Lysimachia*.

† Genera and species hitherto undescribed and new transferals of species from one genus to another, are indicated by heavy face type. Professor Bray, of the University of Texas, has furnished me with notes on the habitat of some of the species.

Leaves with many relatively small leaflets: spikes elongated: ovary sessile: pods straight or merely curved, with woody valves. 2. SIDEROCARPOS.

Pods with membranous or thin-leathery very flat valves.

Ovary stipitate: calyx very short and different from the corolla in texture. 3. HAVARDIA.

Ovary sessile: calyx simulating the corolla, but much shorter, and quite similar in texture.

4. ALBIZZIA.

Valves of the pod separating from the continuous margin.

5. LYSILOMA.

Filaments distinct, or the inner ones sometimes slightly united at the base.

Ovary stipitate: petals distinct or united, commonly only to below the middle: pods flat, dry, the seeds not in two distinct rows.

6. ACACIA.

Ovary sessile: petals united into a tubular-funnelform shallowy lobed corolla: pods nearly terete or broader than high, pulpy within, the seeds in two separate rows. 7. VACHELLIA.

Stamens as many as the petals or the corolla-lobes or twice as many.

Anthers without glandular appendages at the top.

Valves of the pod not separating from the continuous margin.

Shrubs or trees: seeds transverse in the pod.

8. LEUCAENA.

Herbs: seeds lengthwise or oblique in the pod.

9. ACUAN.

Valves of the pod separating from the continuous margin.

Pods slightly, if at all, flattened, 4-angled or with a broad margin, beaked, not jointed. 10. MORONGIA.

Pods flat, jointed, not beaked. 11. MIMOSA.

Anthers, at least in the bud, topped by glandular appendages.

Herbs: pods flat and thin, twice or thrice longer than broad.

12. NEPTUNIA.

Shrubs or trees: pods relatively thick, many times longer than broad.

Pods straight or merely curved, somewhat constricted between the seeds, in lax clusters. 13. PROSOPIS.

Pods tightly coiled into a spiral, in bunch-like clusters.

14. STROMBOCARPA.

1. PITHECOLOBIUM Mart. Flora, **20**: Part 2, Beibl. 114. 1837.

Leaflets leathery: petioles shorter than the petiolules: ovary pubescent.

1. *P. Guadalupense.*

Leaflets membranous: petioles longer than the petiolules: ovary glabrous.

2. *P. Unguis-Cati.*

1. Pithecolobium Guadalupense (Pers.) Chapm.

Mimosa Guadalupense Pers. Syn. **2**: 262. 1805.

Pithecolobium Guadalupense Chapm. Fl. S. States. 116. 1860.

In sand, Key West, Florida. Also in tropical America.

2. Pithecolobium Unguis-Cati (L.) Benth.

Mimosa Unguis-Cati L. Sp. Pl. 517. 1753.

Pithecolobium Unguis-Cati Benth. Lond. Journ. Bot. **3**: 200. 1844.

In sand, southern peninsular Florida and the Keys. Also in tropical America.

2. SIDEROCARPOS.

Trees with spreading branches and zigzag twigs. Leaves alternate, but often clustered: blades 2-pinnate, with 4–6 pinnae: leaflets relatively few. Flowers mostly perfect, in cylindric spikes. Calyx campanulate, 5-lobed, very different from the corolla. Corolla 5-lobed, the lobes longer than the tube. Stamens numerous: filaments united below. Ovary sessile: style filiform. Ovules numerous. Pods stout and turgid, very tardily dehiscent, the valves woody, enclosing a soft tissue which separates the seeds from each other. Seeds transverse, on straight funicles.

From σίδηρος, *iron*, and καρπός, *fruit*, in reference to the very hard valves of the pod of the following species.

Distinguished from related genera by the characters given in the generic key.

1. Siderocarpos flexicaulis (Benth.)

Acacia flexicaulis Benth. Lond. Journ. Bot. **1**: 505. 1842.

Pithecolobium Texense Coult. Cont. Nat. Herb. **1**: 27. 1890.

Pithecolobium flexicaule Coult. Bot. Gaz. **15**: 270. 1890.

On bluffs, Texas and adjacent Mexico.

3. HAVARDIA.

Small evergreen trees, sometimes shrubby, armed with stipular spines. Leaves alternate: blades 2-pinnate, with

6–10 pinnae: leaflets numerous (20–40 in each pinna), relatively small. Flowers perfect, in head-like spikes. Calyx quite short, 5-lobed, very different from the corolla in shape and texture. Corolla 5-lobed, the lobes shorter than the tube. Stamens numerous: filaments united below. Ovary stipitate: style filiform. Ovules several. Pods flat, readily dehiscent, with membranous or thin-leathery valves. Seeds few.

(In honor of Dr. Valery Havard, U. S. Army, a diligent student of the North American flora.)

Distinguished from related genera by the characters given in the generic key.

1. HAVARDIA BREVIFOLIA (Benth.)

Pithecolobium brevifolium Benth.; A. Gray, Pl. Wright. **1**: 67. 1852.

In valleys, southern Texas and northern Mexico.

4. ALBIZZIA Durazz. Mag. Tosc. 3: IV. 11. 1772.

1. ALBIZZIA JULIBRISSIN Durazz.

Albizzia Julibrissin Durazz. Mag. Tosc. **3**: IV. 11. 1772.

In sandy soil and open woods, Virginia to Arkansas, Florida and Texas. Naturalized from Asia.

5. LYSILOMA Benth. Lond. Journ. Bot. 3: 82. 1844.

1. LYSILOMA LATISILIQUA (L.) Benth.

Mimosa latisiliqua L. Sp. Pl. 519. 1753.

Lysiloma latisiliqua Benth. Trans. Linn. Soc. **30**: 534. 1875.

In sandy soil, Florida Keys, and in the West Indies.

6. ACACIA Adans. Fam. Pl. 2: 319. 1763.

Leaflets of each pinna mostly more than 20.
- Pods over 15 mm. broad: the ultimate divisions of the leaf-rachis puberulent. . 1. *A. Berlandieri.*
- Pods less than 10 mm. broad: the ultimate division of the leaf-rachis glabrous or with few long hairs.
  - Leaflets of each pinna 40–100, acute. 2. *A. filicioides.*
  - Leaflets of each pinna 20–30, blunt. 3. *A. cuspidata.*

Leaflets of each pinna mostly less than 20.
- Flowers in head-like spikes.

Pods less than 8 mm. broad, contracted between the seeds: leaflets less than 1 mm. broad. 4. *A. constricta.*
Pods over 15 mm. broad, not constricted between the seeds: leaflets over 2 mm. broad. 5. *A. Roemeriana.*
Flowers in elongated spikes or racemes.
Pods over 10 mm. broad.
Flowers slender-pedicelled. 6. *A. Wrightii.*
Flowers sessile or nearly so. 7. *A. Greggii.*
Pods less than 10 mm. broad. 8. *A. amentacea.*

1. ACACIA BERLANDIERI Benth.

Acacia Berlandieri Benth. Lond. Journ. Bot. **1**: 522. 1842.

On dry bluffs and volcanic mounds, southern Texas and Mexico.

2. ACACIA FILICIOIDES (Cav.) Trelease.

Mimosa filicioides Cav. Icon. **1**: 55. *pl. 78.* 1791.

Acacia filicioides Trelease; Branner & Coville, Rep. Geol. Surv. Ark. **1888**: Part 4, 178. 1891.

On prairies and in sandy soil, Missouri and Kansas to Texas, Arizona and Mexico, and in Florida. The wholly or partially glabrous form, occurring in Texas and Florida, is *A. filicioides Texensis:* [*Acacia Texensis* T. & G. Fl. N. A. **1**: 404. 1840].

3. ACACIA CUSPIDATA Schlecht.

Acacia cuspidata Schlecht. Linnaea, **12**: 573. 1838.

In dry soil, Texas to Arizona.

4. ACACIA CONSTRICTA Benth.

Acacia constricta Benth.; A. Gray, Pl. Wright. **1**: 66. 1852.

On gravelly terraces and slopes, southern Texas to New Mexico and adjacent Mexico.

5. ACACIA ROEMERIANA Scheele.

Acacia Roemeriana Scheele, Linnaea, **21**: 456. 1848.

On limestone hills, southern Texas, New Mexico and Mexico.

6. ACACIA WRIGHTII Benth.

Acacia Wrightii Benth.; A. Gray, Pl. Wright. **1**: 64. 1852.

In dry soil, Texas, New Mexico and adjacent Mexico.

7. ACACIA GREGGII A. Gray.

Acacia Greggii A. Gray, Pl. Wright. **1**: 65. 1852.

In limestone soil and gravelly terraces, Texas and Mexico.

8. ACACIA AMENTACEA DC.

Acacia amentacea DC. Prodr. **2**: 455. 1825.

On plains and hillsides, Texas, from the Guadalupe River to the Pecos, and in northern Mexico.

7. VACHELLIA Wight & Arn.* Prodr. Fl. Ind. 272. 1834.

Shrubs or small trees, with spreading branches and straight spines. Leaves alternate: blades 2-pinnate, with 8–16 pinnae: leaflets numerous (20–50 in each pinna), relatively small. Flowers polygamous, in globular spikes. Calyx simulating the corolla but only about ½ as long, shallowly 5-lobed. Corolla tubular-funnelform, shallowly 5–6-lobed, the lobes as broad as high. Stamens very numerous: filaments distinct. Ovary sessile: style filiform. Pod stout, turgid, nearly terete or usually broader than high, scarcely dehiscent, filled with a pulp which separates the two rows of seeds and the individual seeds from each other.

1. VACHELLIA FARNESIANA (L.) Wight & Arn.

Mimosa Farnesiana L. Sp. Pl. 521. 1753.

Acacia Farnesiana Willd. Sp. Pl. **4**: 1083. 1806.

Vachellia Farnesiana Wight & Arn. Prodr. Fl. Ind. 272. 1834.

On sandy or clayey plains and prairies, southern Texas and Mexico, and naturalized in Florida. Widely distributed in tropical and warm countries.

8. LEUCAENA Benth. Lond. Journ. Bot. **4**: 416. 1842.

Leaves with 15–18 pairs of pinnae: branches tomentose: leaflets less than 1.5 mm. broad. 1. *L. pulverulenta.*

Leaves with 2–8 pairs of pinnae: branches glabrous or glabrate: leaflets over 1.5 mm. broad.

* Specimens of a species representing a related genus were collected by Mr. Heller at Corpus Christi, Texas, in 1894; but the material at hand is insufficient for satisfactory study.

Leaflets 20-40, mostly thrice as long as broad: pods with membranous valves. 2. *L. glauca.*

Leaflets 12–16, mostly less than twice as long as broad: pods with leathery valves. 3. *L. retusa.*

1. LEUCAENA PULVERULENTA (Schlecht.) Benth.

Acacia pulverulenta Schlecht. Linnaea, **12**: 571. 1838.

Leucaena pulverulenta Benth. Lond. Journ. Bot. **4**: 417. 1842.

In rich soil, southern Texas and Mexico.

2. LEUCAENA GLAUCA (L.) Benth.

Mimosa glauca L. Sp. Pl. 520. 1753.

Leucaena glauca Benth. Lond. Journ. Bot. **4**: 416. 1842.

In sandy or rocky soil, Florida to Texas and Mexico. A native of tropical America, now widely distributed in tropical regions.

3. LEUCAENA RETUSA Benth.

Leucaena retusa Benth.; A. Gray, Pl. Wright. **1**: 64. 1852.

On plains and prairies, southern Texas and New Mexico.

9. ACUAN Medic. Theod. Sp. 62. 1786.

[*Desmanthus* Willd. Sp. Pl. **4**: 1044. 1806.]

Stamens 5.
- Pods 4–6 mm. wide, in compact heads: peduncles longer than the pods. 1. *A. Illinoensis.*
- Pods 2 mm. wide, in loose clusters: peduncles shorter than the pods. 2. *A. leptiloba.*

Stamens 10.
- Leaves mostly with 8–12 pinnae.
  - Stems glabrous or nearly so: peduncles 1–2 cm. long. 3. *A. Jamesii.*
  - Stems velvety pubescent: peduncles 2.5–5 cm. long. 4. *A. velutina.*
- Leaves mostly with 2–6 pinnae.
  - Peduncles 1–2.5 cm. long.
    - Leaf-rachis and its branches glabrous: leaflets not ciliate. 5. *A. depressa.*
    - Leaf-rachis and its branches pubescent: leaflets ciliate. 6. *A. acuminata.*
  - Peduncles 4–12 cm. long.

Pinnae mostly with 12–18 leaflets: leaflets glaucous beneath, glabrous or nearly so: pods 3 mm. wide.
7. *A. reticulata.*

Pinnae mostly with 20–28 leaflets: leaflets ciliate and pubescent beneath: pods 2 mm. wide. 8. *A. fallax.*

1. ACUAN ILLINOENSIS (Michx.) Kuntze.

Mimosa Illinoensis Michx. Fl. Bor. Am. **2**: 254. 1803.
Acuan Illinoensis Kuntze, Rev. Gen. Pl. 158. 1891.
In dry soil and on river banks, Minnesota to Tennessee, Florida, Kansas and Texas.

2. ACUAN LEPTILOBA (T. & G.) Kuntze.

Desmanthus leptilobus T. & G. Fl. N. Am. **1**: 402. 1840.
Acuan leptiloba Kuntze, Rev. Gen. Pl. 158. 1891.
On prairies, Kansas to Texas.

3. ACUAN JAMESII (T. & G.) Kuntze.

Desmanthus Jamesii T. & G. Fl. N. Am. **1**: 402. 1840.
Acuan Jamesii Kuntze, Rev. Gen. Pl. 158. 1891.
In dry soil, Indian Territory to Texas and Arizona.

4. ACUAN VELUTINA (Scheele) Kuntze.

Desmanthus velutinus Scheele, Linnaea, **21**: 455. 1848.
Acuan velutina Kuntze, Rev. Gen. Pl. 158. 1891.
In dry usually calcareous soil, southern and western Texas.

5. ACUAN DEPRESSA (H. & B.) Kuntze.

Desmanthus depressus H. & B.; DC. Prodr. **2**: 444. 1825.
Acuan depressa Kuntze, Rev. Gen. Pl. 158. 1891.
In sandy soil, near the coast, Florida to Texas and Mexico.

6. ACUAN ACUMINATA (Benth.) Kuntze.

Desmanthus acuminatus Benth. Lond. Journ. Bot. **4**: 357. 1842.
Acuan acuminata Kuntze, Rev. Gen. Pl. 158. 1891.
In sandy soil, southern Texas.

7. ACUAN RETICULATA (Benth.) Kuntze.

Desmanthus reticulatus Benth. Lond. Journ. Bot. 4: 357. 1842.

Acuan reticulata Kuntze, Rev. Gen. Pl. 158. 1891.

In dry soil, often on arid hills, southern Texas.

8. ACUAN FALLAX.

Stems branched at the base, the branches spreading or prostrate, 1–2 dm. long, finely canescent, angled. Leaves with 4–8 pinnae: leaflets mostly 20–28, oblong, slightly inequilateral, 3–5 mm. long, rather obscurely reticulated, acutish: peduncles elongated, 3–7 cm. long, surpassing the subtending bracts: spikes about 1 cm. in diameter: pods linear, 3–4 cm. long, slightly curved, acute.

In dry soil, San Diego, Texas. Type collected by Miss Mary B. Croft, during the years 1885–6, no. 162, specimen in the herbarium of Columbia University.

10. MORONGIA Britton,* Mem. Torr. Club, 5: 191. 1894.

[*Schrankia* Willd. Sp. Pl. 4: 1041. 1806. Not Medic. 1792.]

Leaflets prominently nerved beneath. 1. *M. uncinata.*
Leaflets scarcely, if at all, nerved.
Sides and margins of the pods with similar or nearly similar prickles. 2. *M. angustata.*
Sides and margins of the pods with conspicuously dissimilar prickles.
Pods scarcely flattened, the sides with long and broad prickles, the margins nearly unarmed ; beak 10–15 mm. long. 3. *M. latidens.*
Pods markedly flattened, the sides with very fine prickles, the margins with stouter prickles ; beak 4–5 mm. long. 4. *M. Roemeriana.*

1. MORONGIA UNCINATA (Willd.) Britton.

Schrankia uncinata Willd. Sp. Pl. 4: 1043. 1806.

Morongia uncinata Britton, Mem. Torr. Club, 5: 191. 1894.

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*A Mexican species, *Morongia aculeata*, has been reported from Texas, but I have not yet been able to examine authentic or satisfactory specimens. Species additional to those here recognized have been described by Michaux and Chapman, but I have not yet been able to segregate them.

In dry soil, sand or gravel, Virginia and South Dakota to Florida and Texas.

2. MORONGIA ANGUSTATA (T. & G.) Britton.

Schrankia angustata T. & G. Fl. N. Am. **1**: 400. 1840.

Morongia angustata Britton, Mem. Torr. Club, **5**: 191. 1894.

In dry soil, Virginia to Tennessee, Texas and Florida.

3. **MORONGIA LATIDENS.**

Perennial, bright green. Stems 3–10 dm. long, with conspicuously pale and sharp angles and still paler prickles: leaves with 4 pinnae or rarely some of them with only 2 pinnae; leaflets thick, oblong, 3–8 mm. long, apiculate, not nerved: peduncles much stouter than the petioles, with few pale prickles: pod stout, 3–7 cm. long, the sides with broad prickles, the broad margins scarcely or only slightly armed; beak 1–1.5 cm. long.

In dry soil, Kenedy, Carnes County, Texas. Type, Heller, Pl. So. Texas, no. 1779, in the herbarium of Columbia University.

4. MORONGIA ROEMERIANA (Scheele) Heller.

Schrankia Roemeriana Scheele, Linnaea, **21**: 456. 1848.

Morongia Roemeriana Heller, Cont. F. & M. Coll. **1**: 44. 1895.

In stony soil, Texas.

11. MIMOSA L. Sp. Pl. 516. 1753.

Stamens as many as the corolla-lobes. 1. *M. pudica.*
Stamens twice as many as the corolla-lobes.
  Shrubs or trees with hard wood.
    Branchlets and petioles or their divisions glabrous.
      Leaves usually with 2 pinnae; leaflets 6–10, oval or orbicular-oval, 2–4 mm. long: pods armed. 2. *M. borealis.*
      Leaves usually with 4–6 pinnae; leaflets usually 12, oblong or oblong-obovate, 4–6 mm. long: pods unarmed or nearly so. 3. *M. fragrans.*
    Branches and petioles or their divisions puberulent or pubescent.
      Leaves with 2–4 or rarely 6 pinnae; leaflets 4–12. 4. *M. Texana.*

Leaves with 6–many pinnae ; leaflets numerous.
5. *M. Lindheimeri.*

Herbs or undershrubs, or soft-woody climbing shrubs.

Climbing : foliage tomentose or puberulent : leaflets less than twice as long as broad. 6. *M. malacophylla.*

Prostrate and creeping or erect : foliage strigose or strigillose : leaflets over twice as long as broad.

Erect or ascending : peduncles becoming 1–2 cm. long : pods 8–15-seeded. 7. *M. Berlandieri.*

Prostrate : peduncles becoming 5–20 cm. long : pods 2–4-seeded.
8. *M. strigillosa.*

1. MIMOSA PUDICA L.

Mimosa pudica L. Sp. Pl. 518. 1753.

In waste places, about the cities of the Gulf States. Naturalized from tropical America.

2. MIMOSA BOREALIS A. Gray.

Mimosa borealis A. Gray, Mem. Am. Acad. (II) **4**: 39. 1849.

On bluffs and terraces, Indian Territory and Texas.

3. MIMOSA FRAGRANS A. Gray.

Mimosa fragrans A. Gray, Bost. Jour. Nat. Hist. **6**: 182. 1850.

In arid soil, limestone and granite hills, Texas and New Mexico.

4. **MIMOSA TEXANA** (A. Gray).

Mimosa borealis var. ? *Texana* A. Gray, Pl. Wright. **1**: 61. 1852.

On plains and prairies, Texas to New Mexico and adjacent Mexico.

5. MIMOSA LINDHEIMERI A. Gray.

Mimosa Lindheimeri A. Gray, Bost. Jour. Nat. Hist. **6**: 182. 1850.

On bluffs and terraces, southern and western Texas.

6. MIMOSA MALACOPHYLLA A. Gray.

Mimosa malacophylla A. Gray, Bost. Jour. Nat. Hist. **6**: 182. 1850.

In dry soil, Texas to New Mexico and Nuevo Leon,

Mexico. The form with merely puberulent stems and branches, and rather larger glabrous leaflets, is *Mimosa malacophylla glabrata* Benth.

7. MIMOSA BERLANDIERI A. Gray.

Mimosa Berlandieri A. Gray; Torr. Bot. Mex. Bound. Surv. 61. 1859.

In low grounds, southern Texas and San Luis Potosi, Mexico.

8. MIMOSA STRIGILLOSA T. & G.

Mimosa strigillosa T. & G. Fl. N. Am. **1**: 399. 1840.

On river banks and in moist soil, chiefly near the coast, Florida to Texas.

12. NEPTUNIA Lour. Fl. Cochinch. 653. 1790.

Spikes about 50-flowered, oblong-cylindric. 1. *N. lutea.*
Spikes about 20-flowered, ovoid or oval.
  Bracts and calyx-lobes ciliolate.
    Pinnae 4–6: leaflets merely ciliolate. 2. *N. pubescens.*
    Pinnae 6–10: leaflets ciliate, and pubescent beneath. 3. *N. Lindheimeri.*
  Bracts and calyx-lobes not ciliolate. 4. *N. Floridana.*

1. NEPTUNIA LUTEA (Leavenw.) Benth.

Acacia lutea Leavenw. Am. Journ. Sci. **4**: 61. 1824.

Neptunia lutea Benth. Lond. Journ. Bot. **4**: 356. 1842.

In moist often clay soil, Arkansas and the Indian Territory to Florida and Texas. A Texan form with nearly or quite glabrous branches and peduncles, is known as *Neptunia lutea tenuis* (Benth.) Robinson.

2. NEPTUNIA PUBESCENS Benth.

Neptunia pubescens Benth. Lond. Journ. Bot. **4**: 356. 1842.

In dry soil, southern Texas and tropical America.

3. NEPTUNIA LINDHEIMERI Robinson.

Neptunia Lindheimeri Robinson, Proc. Am. Acad. **33**: 333. 1898.

On prairies, Texas.

4. NEPTUNIA FLORIDANA Small.

Neptunia Floridana Small, Bull. Torr. Club, **25**: 138. 1898.

In sand, Florida to Louisiana.

13. PROSOPIS L. Mant. **1**: 10. 1767.

1. PROSOPIS GLANDULOSA Torr.

Prosopis glandulosa Torr. Ann. Lyc. N. Y. **2**: 192. *pl. 2.* 1828.

On plains or prairies, Kansas to Texas, Arizona and Mexico.

14. STROMBOCARPA A. Gray, Bost. Jour. Nat. Hist. **5**: 243. 1845.

Shrubs or trees, with axillary spines. Leaves alternate: blades 2-pinnate, with short petioles or sessile: pinnae few: leaflets relatively few. Flowers perfect, in cylindric or globular spikes. Calyx 5-lobed, campanulate or turbinate. Corolla of 5 distinct or slightly united petals. Stamens 10: filaments distinct. Ovules numerous. Pods tightly coiled into a spiral, and disposed in dense clusters, woody without, pulpy within.

1. STROMBOCARPA CINERESCENS A. Gray.

Strombocarpa cinerescens A. Gray, Pl. Wright. **1**: 60. 1852.

In moist soil, along the lower Rio Grande, southern Texas and Mexico.

Contributions to the Botany of the Yukon Territory.

1. An Enumeration of the Hepaticae collected by R. S. Williams, 1898–1899.

BY MARSHALL A. HOWE.

Mr. Williams' collection of Hepaticae is of much interest inasmuch as it contains one species which appears to be entirely new, one which has not before been reported from this

continent, five others new to the Alaska region, and besides these two or three which have been rarely collected in America. With the exception of the collections made by the Harriman Alaska Expedition in 1899 and reported upon by Dr. Alexander W. Evans,* the number of species—24—secured by Mr. Williams is greater than that brought from Alaska † by any other collector. The literature bearing upon the Alaskan Hepaticae has been so fully discussed in the recent paper by Dr. Evans that nothing on that point need now be said.

Marchantia polymorpha L. West Dawson, July 30, 1899.

Metzgeria pubescens (Schrank) Raddi. On rocks, Cañon City, March 27, 1898.

Gymnomitrium coralloides Nees. On rocks, Lake Lindeman, May 5 and 8, 1898. In cañon above Lake Lindeman, April 8, 1898.

Marsupella emarginata (Ehrh.) Dumort. Sheep Camp, March 29, 1898. A variety, also, of this species on rocks above Long Lake, May 24, 1898.

Nardia scalaris (Schrad.) S. F. Gray. Dawson, September 11 and October 2, 1898. Mixed with *Lophozia Floerkii*.

Jungermannia cordifolia Hook. Abundant in streams running into Lake Lindeman, April 9, 1898. Mixed with *Scapania undulata*. The leaves are more rigid and the leaf-cells have larger trigones than is normal, but the plants (sterile) agree with *J. cordifolia* in size, habit, form of leaves, etc.

LOPHOZIA RUTHEANA (Limpr.). (*Jungermannia Rutheana* Limpr. Jahresb. Schles. Gesell. vaterl. Cult. **61**: 207. 1884. *Jungermannia lophocoleoides* Lindb. Medd. Soc. Faun. et Fl. Fenn. **14**: 66. 1887. Kongl. Sv. Vet.-Akad. Handl. **23**[5]: 41. 1889.) Paroicous. The species was originally described as dioicous. Lindberg, however, called attention

* Proc. Wash. Acad. Sci. **2**: 287–314. *pl. 16–18.* 10 O. 1900.

† The word "Alaska" is employed in the present paper in a geographical rather than political sense. Most of Mr. Williams' specimens came from British soil.

to the great similarity between it and his paroicous *J. lophocoleoides*, suggesting the possibility that it had not been rightly interpreted, owing to poverty of material. In a copy of the original diagnosis sent out by Limpricht, the "Diöcisch" has been replaced by a pen-and-ink "Paröcisch," indicating the recognition of an error in the first description.

Lophozia heterocolpa (Thed.) M. A. Howe. Over rocks and earth on mountain side, Dawson, August 7 and September 7, 1898.

Lophozia incisa (Schrad.) Dumort. On *Sphagnum*, Klondike, September 18, 1898.

Lophozia barbata (Schreb.) Dumort. Klondike River bottom, October 9, 1898. New to Alaska.

Lophozia Floerkii (Web. & Mohr) Schiffn. On wet rocks, Lake Lindeman, May 30, 1898.

Lophozia lycopodioides (Wallr.) Schiffn. Very common among bushes, Lake Lindeman, May 22, 1898. New to Alaska.

Lophozia quinquedentata (Huds.) Schiffn. On rocks, Klondike, October 10, 1898. Mixed with the following species.

Lophozia saxicola (Schrad.) Schiffn. On rocks, Klondike, October 10, 1898. We have seen but two other American specimens of this, both in the herbarium of Professor Underwood. One bears the inscription "Moore Factory, Canada, in herb. Tayl., Greville, 1843." This was probably collected by Drummond. The other was collected by Prof. J. Macoun, August, 1882, in "alpine situations, Mount Albert, Gaspé, Canada," and was issued as no. 236 of Carr. & Pears. Hep. Brit. Exsicc. According to Herr Stephani,* the species was collected in Alaska by the Drs. Krause, also.

Lophozia minuta (Crantz) Schiffn. On rocks, Lake Lindeman, May 24, 1898. In a swamp, Dawson, September 8, 1898.

Mylia anomala (Hook.) S. F. Gray. On *Sphagnum*, Dawson, August 31, 1898. New to Alaska.

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* Engler's Bot. Jahrb. **8**: 97. 1887.

Geocalyx graveolens (Schrad.) Nees. Dawson, August 31, 1898. Gemmiferous. New to Alaska.

Odontoschisma sphagni (Dicks.) Dumort. In swamp, Dawson, September 8, 1898. New to Alaska.

Blepharostoma trichophyllum (L.) Dumort. On river bank below Bonanza Creek, Klondike, June 18, 1899.

TEMNOMA SETIFORMIS (Ehrh.). (*Jungermannia setiformis* Ehrh. Beitr. 3: 80. 1788.) On rocks, Lake Lindeman, May 5, 1898.

Ptilidium ciliare (L.) Nees. On ground in woods, Dawson, September 7, 1898.

Diplophylleia taxifolia (Wahlenb.) Trevis. On rocks, Cañon City, March 27, 1898.

Scapania undulata (L.) Dumort. In streams running into Lake Lindeman, April 9 and May 21, 1898. Also a variety in still water, Lake Lindeman, May 23, 1898. A very peculiar plant, probably to be considered a variety of this species, was collected by Mr. Williams "in springs between Lakes Lindeman and Bennett, June 2, 1898." The leaf-lobes in this are almost wholly separate, as sometimes happens in *S. uliginosum*, but it differs from the latter species in the acute and dentate-margined lobes.

Scapania imbricata sp. nov.

Yellowish green, becoming somewhat brown, densely caespitose: stems (secondary) prostrate or subascending, plane at apices, 2–4 cm. long, .4–.57 mm. (22–28 cells) in thickness, brown, simple or sometimes sparingly and irregularly branched, root-hairs obsolescent: leaves for the most part very densely imbricate, of nearly uniform size throughout, rigid and subconchiform when dry, or slightly wrinkled, not decurrent, bipartite for $\frac{3}{5}$–$\frac{4}{5}$ their length, the carina slightly or not at all alate; lobes very entire; ventral lobes twice as large as the dorsal or subequal, oblong, oblong-ovate, or elliptical, 1.8–2.2 mm. × .96–1.34 mm., patent-horizontal, the very obtuse often subtruncate apex deflexed, the ventral margin nearly plane; dorsal lobes elliptical-ovate or ovate, suberect or erecto-patent, inflato-convex, appressed-imbricate, rounded-obtuse; leaf-cells near the margin subquadrate or elliptical-oblong, 12–22 μ, firm-walled, those near the middle of lamina

5- or 6-angled, 16–30 μ, with pronounced trigones, cuticle smooth or very slightly roughened. (Plate 14.)

On rocks, Crater Lake, at foot of Chilcoot Pass, altitude about 900 m., May 24, 1898. Although Mr. Williams' specimen is wholly sterile, the peculiarities of the species are so striking that we think our description and figures will make possible its easy recognition. We are unacquainted with any *Scapania* which seems closely related to this species. *Scapania Kaurini* Ryan, from Norway, has obtuse, entire or subentire leaf-lobes but here the resemblance ceases, for *S. Kaurini* is a much smaller plant in every way, its leaves increase in size toward the stem-apex, are commonly subvertical, and are less deeply lobed, the dorsal lobes are not at all imbricate unless at the very apex of the stem, the ventral lobes are ovate or obovate, the root-hairs are numerous, etc. The arrangement of the leaf-lobes in *Scapania imbricata* is quite suggestive of the genus *Diplophylleia*, yet the plant is doubtless a true *Scapania*.

Explanation of Plate 14.

Figs. 1 and 2. Stems (secondary), natural size.
Fig. 3. From near base of stem, dorsal view, × 7.
Fig. 4. Apical portion, dorsal view, × 7.
Figs. 5 and 6. Portions of stem with typical leaves, dorsal view, × 12.
Figs. 7 and 8. Same portions, ventral view, × 12.
Figs. 9 and 10. Single leaves viewed from outer (lower) surface, × 12.
Fig. 11. Leaf cells from apex of ventral lobe, showing margin, × 245.
Fig. 12. Leaf-cells from middle of ventral lobe, × 245.
Fig. 13. Cross-section of (secondary) stem, × 40.
Fig. 14. Cells from near surface in cross-section of (secondary) stem, × 245.

2. An Enumeration of the Mosses collected.

By R. S. Williams.

Our party arrived at Dyea, Alaska, March 23, 1898, and a day or two later a few specimens of mosses were collected in the immediate vicinity, from which time on collections were made at intervals as opportunity offered till Dawson was reached on the 21st of June. On our arrival the streets of

Dyea, scarcely above tide water, were quite bare, but a mile or two above town and on the mountain sides snow was in more or less abundance and constantly increasing in amount as one went back from the coast. The nights were not very cold, about such, perhaps, as might occur in New York City during February. Dyea Creek at the mouth of which the town of that name was located (it is scarcely an inhabited town any longer, the travel all going by way of Skagway) is some 16 miles long. About half way up is the place called Cañon City where the gulch narrows for a mile or two often to only a few rods in width. Here the rocks, where exposed, were often covered with fine growths of mosses and lichens, but there was too much snow and frost to do any satisfactory collecting. About 4 miles farther up the gulch was Sheep Camp, the last place where wood for fuel could be obtained till after crossing the Chilcoot Pass. We camped here from the 28th of March to the 7th of April, and although the ground was everywhere covered with 2 or 3 feet or more of snow, a number of specimens were obtained from the trunks of trees and exposed rocks. Chilcoot Pass is 3,500 feet high and the mountain summits near, 2,000 or 3,000 feet higher. Just beyond the Pass, Crater Lake lies in a small depression at the foot of a steep hill and ten miles away is Lake Lindeman, at an elevation of 2,170 feet. This last lake is the nearest point to the coast where boats can be built and run into the Yukon and we camped here from the 7th of April to the first of June. Quite a number of specimens were obtained during this time although the ground was well covered with snow up to the middle of May. By the 25th of the month the lower hills and mountain sides were mostly bare and the ice in the upper half of the lake had largely melted. Frogs were first heard croaking in a marsh May 16th and on the 26th a single small buttercup was found in bloom close to the lake shore, while sedges were appearing above ground with green tips an inch or so long. Leaving Lindeman the first day of June we sailed down to the foot of the lake (5 or 6 miles only) and camped for 5 days. Vegeta-

tion was found to be considerably more advanced than at the head of Lindeman owing doubtless to the somewhat smaller snowfall and the dryer, more sandy soil. A lupine, one or two violets and a species of *Ribes* were in full bloom, *Equisetum arvense* was in good fruit and a young fern had reached a height of 5 or 6 inches on June 2d. But little collecting was done here owing to lack of time and as no more stops of any length were made from this place on to Dawson, a distance of 525 miles, but little collecting was really done along the Yukon. At Dawson I remained from the 21st of June, 1898, to the 14th of Aug., 1899, and doubtless a fairly complete collection of the higher plants, mosses and lichens was made, growing within 2 or 3 miles of town. All the mountains near Dawson are low (1,200 or 1,500 feet above town, which has an elevation of some 1,700 feet, I believe) and without snow for 3 months during the warm season. Rains were not very frequent or heavy during the summer spent there and snow fell in winter about 16 inches deep in town and perhaps twice that amount on the mountains near.

Aug. 14, 1899, I left Dawson, coming out by the same route as that traversed going in till the head of Lake Bennett was reached on the 25th. Frequent stops along the Yukon allowed the collection of some flowering plants at this season as did a stop over night at Bennett City. On the 26th I took the train at this place for Skagway. We started at 7.15 A. M., reached the White Pass Summit (elevation 2,600 feet) at 9.25 A. M. where a stop-over of 1¼ hours gave time to obtain a number of specimens just on the line between Alaska and British soil, then we continued on down to Skagway arriving there early in the afternoon where the last collecting of the trip was done while awaiting a steamer for Seattle.

To Mrs. Britton the author is under many obligations for assistance in preparing this list.

Dr. Warnstorf has kindly determined the Sphagnums.

Sphagnum Warnstorfii Russow. Swamps at the head of Lake Lindeman (507).

Sphagnum Warnstorfii purpurascens Russow. Locality of preceding (505).

Sphagnum Girgensohnii Russow. Locality of preceding (506).

Sphagnum fuscum (Schimp.) Klinggr. In swamps about Dawson. In fine fruit the latter part of August. Often used in large quantities for filling the spaces between the logs of buildings (501).

Sphagnum fimbriatum Wils. In swamps about Dawson. Fruiting. Rather rare (502).

Sphagnum teres squarrosulum (Lesq.) Schp. Cañon City, Dyea Creek. On damp mountain side (509).

Sphagnum squarrosum Pers. Klondike River bottom (513).

Sphagnum squarrosum subsquarrosum Warns. Swamps about Dawson. Fruiting (508).

Sphagnum medium Limpr. Abundantly fruiting in swamps and on cold, wet hillsides about Dawson. This species is also largely used in the building of log houses (516).

Andreaea petrophila Ehrh. Common about Lake Lindeman. In fine fruit May 17. The plants are quite variable in color and length of stem. The leaves are papillose on both sides but most distinctly so on the back in upper part. The cell walls are very thick, the upper cells measure .008 × .008 mm. to .008 × .012 mm., below they are 3–4 times longer than wide (520).

Andreaea petrophila acuminata Schimp. Lake Lindeman. All the specimens examined seemed to be dioicous. The papillae vary greatly on different leaves, often being very prominent on young leaves and scarcely visible on old specimens (523).

Andreaea petrophila parvifolia (Muell.). Sheep camp, Dyea Creek. These specimens are from the original locality of *parvifolia* and agree with a bit of the original collection from Herb. Mueller. They differ from *petrophila* in having rather smaller leaves and mostly dioicous flowers, the ♂ plants being more branching than the ♀ and bearing three or four antheridial buds; paroicous plants occur, however, and there seems to be no reason for considering it other than a variety as above given (519).

Andreaea alpestris (Thed.) Schimp. Sheep Camp, Dyea Creek. This has leaves very similar to the preceding in size and shape, but the leaf cells below are longer, thinner-walled and less pitted. It should, perhaps, be regarded as only a variety of *petrophila*, as Braithwait does (512).

Gymnostomum curvirostrum (Ehrh.) Hedw. Yukon River bluff just below Dawson (524).

Dicranoweisia crispula (Hedw.) Lindb. Common on rocks about Lake Lindeman (555).

Dicranoweisia contermina R. & C. Locality of preceding (556).

Cynodontium Schisti (Wahlb.) Lindb. On earth about ledges of rock. The leaves are roughly papillose on both faces. Upper leaf-cells irregular, not much elongated, up to about .008 mm. long. Rough spores up to .016 mm. Teeth either solid or with two or three perforations above (525).

Cynodontium torquescens (Bruch) Limpr. Lake Lindeman, on thin earth over rock. Dawson, on rock. Leaves papillose, up to 3 mm. long, twice longer and much narrower-pointed than in *alpestris*. Inner perichaetial leaves longer-pointed and less clasping than in *gracilescens*, foliage leaves also narrower above. The perigonium, of two leaves, close under the perichaetium or almost at its side (526).

Cynodontium polycarpum (Ehrh.) Schimp. Common on rock on upper Dyea cr., also just over the Coast Range on streams flowing into Lake Lindeman. The leaves are distinctly serrate above (527).

Cynodontium strumiferum (Ehrh.) DeNot. Lake Lindeman. In crevices of rock (528).

Oncophorus virens (Sw.) Brid. (*Cynodontium virens* Schimp.) About springs between Lakes Lindeman and Bennett. Alar cells sometimes more or less enlarged or inflated (529).

Oncophorus virens serratus (B. & S.) Limpr. (*Cynodontium virens serratum* B. & S.) On earth along streams flowing into Lake Lindeman (792).

Oncophorus virens nigrescens (Schimp.). (*Cynodontium*

virens nigrescens Schimp.) A depressed, blackish variety growing on the margin of an alpine pond just below snow banks about 1000 ft. above Lake Lindeman (791).

Oncophorus Wahlenbergii Brid. (*Cynodontium Wahlenbergii* Hartm.) Common about Dawson on old stumps and logs, in fine tufts, up to 6 cm. high (530).

Dicranella crispa (Ehrh.) Schimp. On damp sandy soil at mouth of Bonanza Creek (552).

Dicranella varia (Hedw.) Schimp. Below Lake Lebarge on Thirty-mile River (551).

Dicranella heteromalla (L.) Schimp. Sheep Camp, Dyea Creek (554).

Dicranella subulata (Hedw.) Schimp. Growing on a thin layer of damp earth over rock at Lake Lindeman (553). These specimens have the upper leaves somewhat serrulate above, thus approaching *curvata*, but the capsule is scarcely elongated, erect and symmetrical enough to be that.

Dicranum fulvellum (Dicks.) Smith.* On rock at Long Lake a few miles below Chilcoot Summit. The specimens are old and blackish with distinctly furrowed capsule. Leaf-cells not pitted and costa .050 mm. wide at base (531).

Dicranum falcatum Hedw. Sterile plants collected on rock at Lake Lindeman. The leaf-cells from apex one-half down are short and angular, often nearly square, the excurrent costa of the upper leaves is very rough with teeth-like projections of the cells, width of costa at base .080 mm. (532).

Dicranum molle Wils. Collected at Lake Lindeman on damp, clayey soil subject to overflow. The specimens bear very immature capsules but show a distinct struma. The leaves are entire or nearly so and erect-spreading, with cell-walls thickened and pitted chiefly a little above the base, the upper cells elongated, often rectangular and 4 to 6 times longer than broad. Costa about .065 mm. wide at base, about $\frac{1}{7}$ leaf base. This species has been previously collected outside of Europe in Alaska and Greenland (546).

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* The *Dicranums* have been kindly revised by Dr. R. F. True, but the notes are by the author.

Dicranum Blyttii B. & S. Rather common on rock about Lake Lindeman. Some specimens are dioicous, male plants occurring with three or four antheridial buds. The leaf-cells vary considerably in width below, with walls sometimes thickened and pitted, especially in the perichaetial leaves a little above the base (533).

Dicranum elongatum Schleich. Dawson. Very common on both old stumps and rocks in damp places. Some of the specimens might be referred to var. *orthocarpum* if that is worth recognition as a variety (534).

Dicranum fuscescens Turn. On rock along Dyea Creek and on earth at Lake Lindeman (536).

Dicranum congestum Brid. On swampy ground at Dawson. Distinguished from the preceding by the wider leaf point with cells elongated-oval, not short and angular above. In both species the cell walls are more or less porose and the nerve at base varies from $\frac{1}{4}$ to $\frac{1}{7}$ the width of leaf base (537).

Dicranum Muhlenbeckii B. & S. Growing among boulders at Lake Lindeman. This has small, angular leaf-cells, often only .006 × .006 mm.–.006 × .008 mm. extending $\frac{3}{4}$ down the leaf or more. The cell walls may be more or less porose. The costa at base is about $\frac{1}{4}$ width of leaf base (538).

Dicranum fragilifolium Lindb. Very common on decayed logs about Dawson. Perichaetial leaves rather gradually narrowed to the subula with cell walls porose in lower part. Other leaves scarcely or not porose. The costa often well defined below and broad, over $\frac{1}{3}$ width of leaf base (535).

Dicranum angustum Lindb. Sterile specimens collected at Lake Lindeman in swamps and found in good fruit at Dawson in July. This is a more slender plant than *scoparium* with erect-spreading, nearly straight, smooth and entire leaves, giving a somewhat bristly appearance to the stems. The leaf-cells are elongated throughout often from 4 to 8 times longer than wide in upper leaf, with walls strongly porose, at least below. Nerve indistinct and narrow a short distance above base. Perichaetial leaves abruptly narrowed to a smooth subula about $\frac{1}{2}$ the length of blade. Capsule

short, curved, furrowed. Annulus of one or two rows of cells. Spores slightly roughened, up to about .023 mm. Kindberg gives this as a plant of northern Europe, occurring principally in Norway, Finland and Lapland (539).

Dicranum majus orthophyllum Al. Br. Fruiting specimens collected at Lake Lindeman. This variety with nearly straight, erect-spreading leaves bears little resemblance to the beautifully falcate-leaved *majus*. The leaves of the Lindeman specimens measure up to 8½ mm. long, with margins serrulate in upper ⅓ and vein somewhat rough on back with low papillae. Leaf-cells elongated throughout and porose nearly to apex, costa percurrent, .045 to .080 mm. wide a little above the broadened base. Capsules clustered, up to 5 in the same perichaetium (544).

Dicranum Bonjeani DeNot. (*D. palustre* Br. and Sch.). On rather dry ground at Lake Lindeman. A variety with straight leaves 4½ mm. long with costa scarcely papillose on back and margin entire or nearly so (543).

Dicranum Bergeri Blandow. (*D. Schraderi* Web. & Mohr.), Lake Lindeman, mouth of Little Salmon River and near Dawson (540).

Fissidens bryoides (L.) Hedw. Common on earth about Dawson (559).

Fissidens osmundoides (Swartz) Hedw. On earth and rocks at Lake Lindeman (557).

Fissidens adiantoides (L.) Hedw. In marshy places at Lake Lindeman (558).

Ceratodon purpureus Brid. Common on rock at Lake Lindeman (560). Sterile specimens of a moss that may be only a variety of this were collected at Marsh Lake on dry rock, in which the leaves are broader than the normal form and only ½ as long (800).

Distichium capillaceum (Sw.) B. & S. On earth and rock from Lake Lindeman to Dawson (561).

Distichium inclinatum (Ehrh.) B. & S. Lake Lebarge on earth and at Dawson on old stumps (562).

Blindia acuta (Huds.) B. & S. Skagway, in fine fruit

Aug. 27, also sterile specimens on dry rock at Lakes Lindeman and Lebarge (563).

Pottia latifolia pilifera (Brid.) Muell. On bare earth of river bluff just below Dawson (564).

Didymodon rubellus (Hoffm.) B. & S. Cañon City, Dyea Creek, also common at Dawson. The apex of the leaf of this species usually terminates in a somewhat enlarged, pale, smooth cell with one or two similar cells on either side, forming teeth that stand out very distinctly from the rest of the rather obscure papillose cells of upper leaf. The capsule varies greatly in length and breadth. Cells of the lid not in oblique rows (565).

Ditrichum giganteum R. S. Williams, sp. nov.

Dioicous. Growing in large cushions up to 12 cm. high, usually of a yellow-green color. Upper stem leaves up to 7 mm. long, narrowly subulate above, sharply denticulate at apex and more or less serrulate or crenulate on border about $\frac{1}{2}$ down, also often rough on back above. Inner perichaetial leaf truncately narrowed to a denticulate subula about equaling the broad part in length. Cell walls thickened throughout except in and near margin at base. Cells in upper leaf 3–5 times longer than wide with rounded ends, in middle near margin, short and irregular, often not or scarcely elongated, toward base several rows in margin narrowly rectangular, 8–10 times longer than wide, with thin walls, within the cells become much wider, thick-walled and near costa, mostly pitted. Capsule oblong-cylindrical, not quite symmetrical, with conical lid $\frac{1}{3}$ its length and broad annulus of 3 rows of cells. Three or 4 rows of elongated cells about mouth of capsule, below the cells becoming irregularly oblong to rectangular, mostly 2–4 times longer than wide. Teeth pale, very papillose, rather broad and irregular, without distinct articulations. (Plate 15.)

This plant is closely related to *flexicaule* with which it has been associated both in this country and Europe, and some of the larger forms of *flexicaule* approach it very closely but I have not yet seen any with such long, slender, serrulate leaves with inner perichaetial leaf truncately narrowed to so dentate a subula. The color and size alone are usually

sufficient to separate the plant. Macoun's no. 66 is this species, also Leiberg's 232. In European collections, "485 Jack, Leiner and Sitzenberger Kryp. Badens," "a" is this and "c" is *flexicaule*. 1307 Rabenhorst, Bry. Eur. looks much like this but is *Dicranodontium*. "111 Bryotheca Silesiaca" and "111 Wilson, Musci Brit." are this species.

Sterile specimens only were collected at Dawson. The description is drawn up from specimens collected at Columbia Falls, Mont., July, 1892. In the plate the teeth are probably figured too short, the only available specimen being in poor condition. The plant grows on both earth and rock and rarely fruits (568).

Ditrichum flexicaule (Schleich.) Hampe. (*Leptotrichum flexicaule* Hampe.) Common about Dawson in swampy places. These specimens are similar to 961, Rabenhorst, Bry. Eur. The leaf-cells below are often much pitted, perichaetial leaves gradually narrowed and leaf towards apex only slightly serrulate. Occasionally there is a distinct cluster of alar cells found in both European and American specimens (567).

Ditrichum flexicaule densum (B. & S.) Braithw. Specimens about 1 cm. high, collected between the Big and Little Salmon rivers, in good fruit June 16. This plant has the habit of *D. homomallum* and Macoun's no. 8, so called, belongs here. It is at once distinguished from *homomallum* by the short, often transversely elongated cells near middle of leaf toward margin, also the rectangular basal cells are only ½ as long. These specimens appear quite distinct from *flexicaule* by their small size, short, nearly entire leaves and scarcely or not pitted cell walls, the teeth also are distinctly articulate; possibly, however, all these characters are too variable to make specific distinctions (566).

Desmatodon cernuus (Hüben) B. & S. Dawson (570).

Barbula brevirostris (Hook. & Grev.) Bench. On earth-covered stumps and bare clayey soil about Dawson (571).

Barbula fallax recurvifolia Wils. (*Barbula reflexa* Brid.) Dawson. Growing in large tufts on rock (572).

Barbula fragilis (Drumm.) B. & S. Dawson. In damp

shady places on earth. Collected with rather old fruit, August 4th. The lid about equals the capsule in length, the calyptra extends nearly $\frac{1}{2}$ down capsule. Teeth red and closely twisted when first exposed, later becoming scarcely twisted. Outer walls of the cells of leaf subula much thickened (574).

Barbula subulata (L.) Beauv. Dawson. On earth in rather dry places (575).

Barbula ruralis (L.) Hedw. On rocks about Lakes Lindeman and Bennett (576).

Bryobrittonia R. S. Williams, gen. nov.

Closely related to *Tortula* and *Desmatodon* from which it is distinguished by the mamillose leaves, the exposed surfaces of the very distinct cells being highly convex. From *Trichostomum* and *Timmiella* it is distinguished by the costa with only one stereid band; the first of these also has the leaves smooth or papillose and the second has a leaf lamina of 2 layers of cells, mamillose on the upper surface only.

This genus is dedicated to Mrs. Elizabeth G. Britton, by whose aid so many American students of our mosses have been encouraged.

Bryobrittonia pellucida R. S. Williams, sp. nov.

With much the habit of *Tortula latifolia* but leaves much longer and narrower above. Stems mostly simple, radiculose below, in loose, rather dark green tufts up to 2 cm. high, in cross-section irregularly oval (about .320 mm. long) with walls of 2 or 3 rows of slightly thickened irregular cells, ground tissue of large thin-walled cells, surrounding a distinct central strand of numerous small thin-walled cells. Terminal leaves (often enclosing numerous long paraphyses-like hairs) oblong lanceolate, up to 7.5 mm. long and 1.5 mm. broad, plicate and somewhat crispate when dry or rarely nearly straight, mamillose on both faces except dorsal side of costa, crenulate-serrate on flat borders in upper half, obtusely or somewhat acutely pointed, with stout costa (.140 mm. wide near base) long-decurrent on stems and vanishing several cells below apex. Lower leaves ovate-oblong (about

3 mm. long). Leaf-cells above rhomboidal to hexagonal, about .016 mm. in diameter, becoming gradually elongated below and hyaline, the cells near margin a little above base .004–.006 mm. wide and up to .160 mm. long, toward costa .020–.025 mm. wide and up to .100 mm. or more long. Cross-sections of costa show in the ventral half about 4 guide-cells with a few accessory cells or even 1 or 2 rows of accessory cells nearly as large, in addition to the row of mamillose cells on ventral surface. The dorsal half of costa consists of a stereid band, the outer row of cells a little larger than the others with a distinct central strand of small, irregular, thin-walled cells. (Plate 16.)

Yukon River bluff, just below Dawson. Collected April 6, 1899, on rock (587).

Scouleria aquatica Hook. Fine fruiting specimens collected near Cañon City, Dyea Creek. As usual in clear mountain streams, the plants are blackish and robust. Also collected sterile in Miles's Cañon and in fruit on the Yukon at Dawson. These latter specimens are more slender and of a dull green color, such as are usually found in larger streams that become swift and muddy in high water. There seems to be no microscopical differences between the different specimens (588) and (806).

Grimmia conferta Funck. Marsh Lake. This plant has cell walls thin, not or scarcely sinuous, the upper cells roundish, the lower short rectangular, about 1 to 3 (589).

Grimmia apocarpa (L.) Hedw. Lake Lindeman. Growing in blackish tufts on perpendicular walls. This species has cells of leaf above, mostly oblong to square, with thick, sinuate, angular walls, especially near middle, toward base becoming hyaline and long-rectangular with thin walls. The leaf towards apex consists of a double layer of cells throughout; about $\frac{1}{2}$ down the cells are double only in margin and here and there within (591).

Grimmia apocarpa gracilis Web. & Mohr. Lake Lindeman. The cell structure of the leaves is similar to the preceding, I believe. The plant differs in being rather more slender, with leaves more papillose and lateral appearing fruit (592).

Grimmia rivularis Brid. Lake Lindeman. On rock near water-line. This plant has rather obtuse leaves, mostly somewhat sinuate dentate above. The cell walls are less thickened and angular than in *apocarpa*, and the lower cells shorter rectangular and broader (593).

Grimmia torquata Hornsch. Sterile specimens collected at Sheep Camp, Dyea Creek; also at Lakes Lindeman and Bennett. The typical form has leaves more or less curved and twisted in various directions (596). In other specimens the leaves all twist about the stem in the same direction, presenting a very rope-like appearance (598). The tufts may finally become of a dull, brownish-black throughout. Some small, brownish-green tufts only 1 cm. high were collected at Lake Bennett, apparently young plants. The leaves are short, with scarcely thickened or sinuous cell walls. Propagula, mostly at the base of the costa beneath, resemble those of ordinary *torquata* (599).

Grimmia ovalis (Hedw.) Lindb. (*Grimmia ovata* Schwaegr.) Lake Lindeman and Dawson and at various intermediate points on the Yukon. Common (595).

Grimmia tenuicaulis R. S. Williams, Bull. Torr. Bot. Club, **27**: 316–317. 1900. Dawson on rather dry rock walls. Specimens not quite so slender as the type (590).

Grimmia acicularis (L.) C. M. (*Racomitrium aciculare* Brid.) Lake Lindeman (601).

Grimmia microcarpa (Hedw.) C. M. (*Racomitrium Sudeticum* (Hedw.) B. & S.) Lake Lindeman. Limpricht states the leaf margin in this species consists of 2 layers of cells, distinguishing it from *heterostichum* which has only one. In these specimens the margin above consists sometimes of a double layer, on one side, at least (602).

Grimmia heterosticha (Hedw.) C. M. (*Racomitrium heterostichum* Brid.) Lake Lindeman and Skagway. Leaf border of a single layer of cells (603).

Grimmia fascicularis (Schrad.) C. M. (*Racomitrium fasciculare* (Schrad.) Bridel.) Lake Lindeman (605).

Grimmia ramulosa Lindb. (*Racomitrium microcarpum* (Schrad) Brid.) Lake Lindeman (606).

Grimmia canescens (Timm.) C. M. (*Racomitrium canescens* Brid.) Sheep Camp, Dyea Creek and Lake Lindeman. Specimens sometimes blackish throughout. The alar cells, more or less hyaline and somewhat inflated-hexagonal, in several rows, seem always to distinguish this plant (608).

Grimmia hypnoides (L.) Lindb. (*Racomitrium lanuginosum* Brid.) Lake Lindeman (607).

Hedwigia albicans (Web.) Lind. (*H. ciliata* Ehrh.) Common about Dawson in fine fruiting tufts with stems up to 8 cm. long, also collected at Lake Bennett (610).

Amphidium Lapponicum (Hedw.) Schimp. (*Amphoridium Lapponicum* (Hedw.) Schimp.) Lake Lindeman and Lake Marsh (611).

Weissia Drummondii (Hook. & Grev.) Lind. (*Ulota Drummondii* Brid.) On bark of *Alnus* at Sheep Camp, Dyea Creek (612).

Weissia Bruchii (Hornsch.) Lindb. (*Ulota Bruchii* Hornsch.) On rock at Sheep Camp and Lake Lindeman (613).

Weissia ulophylla intermedia (Schimp.) Braithw. (*Ulota crispa intermedia* (Schimp.) Dixon.) Sheep Camp. On *Populus* and *Alnus* (614).

Weissia phyllantha (Brid.) Lindb. (*Ulota phyllantha* Brid.) Skagway, Alaska. On rock just above tide-water. The plants are stout and dark colored, bearing dense clusters of gemmae on both sides of the costa near apex (615).

Orthotrichum anomalum Hedw. Dawson. In fine fruit June 29, on rock. Also collected at Skagway (616).

Orthotrichum Macounii Aust. Dawson. On rock. I refer specimens to this species with a seta about twice the length of the cylindrical capsule, which is at first smooth but may finally become ribbed throughout, with teeth regular and often united to apex and stout cilia (of a double row of cells) often nearly as long as the teeth. The characters pointed out by Austin as separating this species from *Kingianum* are not apparently very constant (617).

Orthotrichum rupestre Schleich. Lake Lindeman (618).

Orthotrichum alpestre Hornsch. Lake Marsh and Dawson. On rock (619).

Orthotrichum speciosum Nees. Skagway, Alaska. On cotton-wood (620).

Orthotrichum obtusifolium Schrad. Skagway. On cotton-wood (621).

Leersia rhabdocarpa (Schwaegr.) Lindb. (*Encalypta rhabdocarpa* Schwaegr.) Dawson (623).

Leersia Selwyni (Aust.) E. G. Britt. (*Encalypta Selwyni* Aust.) Lake Marsh; also common about Dawson (624).

Georgia pellucida (L.) Rab. (*Tetraphis pellucida* (L.) Hedw.) Lake Lindeman (625).

Georgia geniculata (Girgens.) Lindb. (*Tetraphis geniculata* Girgens.) Cañon City, Dyea Creek (626).

Dissodon splachnoides (Thunb.) Grev. & Arn. Lake Lindeman. A few specimens found growing on damp earth by margin of pond. The rhomboidal leaf-cells a little below the apex measure .010 mm. by .025 mm., toward base becoming rectangular with a width of about .008 mm. and from 4 to 6 times longer. Spores up to .036 mm. Synoicous (627).

Tetraplodon angustatus (Sw.) B. & S. Dawson. On bones. In good fruit, May 7. This species often grows mixed with the next and is scarcely to be distinguished by the unaided eye, unless by the little shorter pedicel. The stomata are confined to the upper end of the apophysis, the teeth approximate in fours, not in twos, as given in the L. & J. Manual (805).

Tetraplodon bryoides (Zoeg.) Lindb. (*Tetraplodon mnioides* (Sw.) B. & S.) Dawson. On bones. In fine fruit, July 3. The stomata are scattered over the apophysis and teeth approximate in twos (628).

Tetraplodon urceolatus (Brid.) B. & S. Near summit of Moosehide Mt. just back of Dawson. On bones. In a letter recently received by Mrs. Britton from Mr. H. N. Dixon, speaking of the differences between *T. mnioides cavifolius*

and *T. urceolatus* he states he found "that the areolation of the leaf afforded a very distinct character, that of *urceolatus* being shorter, more rectangular and above all more incrassate, that of all forms of *T. mnioides* being more irregular, more elongated and with thinner walls." He further states that the Labrador plants he has seen all belong to *mnioides* and that possibly we do not have the true *urceolatus* in America. The specimens collected at Dawson, however, entirely agree with European specimens of the latter, the cell characters being just such as pointed out above (622).

Funaria calcarea Wahl. On bare earth of river bluff just below Dawson. This species is only to be separated from *Mediterranea*, apparently, by the slightly more serrate leaf and shorter point. Leaf-cells above about .036 × .060 mm. Teeth with about 12 lamellae, 4 or 5 rows of transversely elongated cells about mouth of capsule and rough spores up to .025 mm. (629).

Funaria hygrometrica (L.) Sibth. Lake Marsh and near Dawson (630).

Funaria hygrometrica arctica Berggrn. Lower Klondike River. The specimens are mostly from 12 to 20 mm. high. Spores up to .024 mm. The spores of *hygrometrica* run up to .016 or .018 mm. (691).

Bartramia ithyphylla (Haller) Brid. Lake Lindeman (631).

Bartramia OEderiana (Gunn.) Swartz. Dawson (632).

Bartramia pomiformis (L.) Hedw. Cañon City and Sheep Camp, Dyea Creek (633).

Philonotis fontana (L.) Brid. Rather common about Lake Lindeman and Lake Bennett (635).

Conostomum boreale Swartz. Growing in dense cushions on wet rock near Long Lake, between Chilcoot Pass and Lake Lindeman (634).

Catoscopium nigritum (Hedw.) Brid. Dawson. In fine fruit about springs, May 7 (636).

Meesea trichodes (L.) Spruce. (*Meesia uliginosa* Hedw.) Dawson. The teeth of the peristome are sometimes almost

up to $\frac{1}{2}$ the segments in length, they are separated by spaces up to $\frac{1}{2}$ the width of the teeth across. Apex of teeth often split or perforated by a single opening. The minutely roughened spores measure up to .048 mm. (637).

Meesea triquetra (L.) Aongstr. (*Messia tristicha* B. & S.) Klondike River bottom. In fine fruit July 23 (639).

Paludella squarrosa (L.) Brid. Sterile specimens growing in bogs at Lake Lindeman. Found abundantly in fruit at Dawson July 23, growing in large patches many feet across. In places, specimens were so mixed with *Camptothecium nitens* that only the tall seta and capsule of *squarrosa* were visible (640).

Leptobryum pyriforme (L.) Schimp. Lake Lindeman and Dawson (641).

Pohlia nutans (Schreb.) Lindb. (*Webera nutans* (Schreb.) Hedw.) Sheep Camp, Dyea Creek, also on an island just below Fort Selkirk (642).

Pohlia nutans var. (*Webera nutans* var.) Lake Lindeman. These specimens are dioicous with appendiculate cilia and costa rough on the back above by the projecting upper ends of the cells. *P. nutans longiseta* is described as having a rough costa, but it has a seta 3 or 4 times longer than these specimens. Limpricht states it attains a height of 10 cm. I have Montana specimens of *nutans* with paroicous inflorescence, seta 2 or 3 cm. high and costa slightly rough on back above, also specimens with seta 6 cm. high and costa smooth (643).

Pohlia cruda (L.) Lindb. (*Webera cruda* (L.) Schimp.) Lake Lindeman (644).

Pohlia sphagnicola (Brid.) Lindb. & Arn. (*Webera sphagnicola* Schimp.) Dawson. In fine fruit July 2. Growing with slender, mostly solitary stems up through tufts of *Sphagnum* and *Aulacomnium*. The specimens are paroicous not dioicous as usually described, with leaves mostly flat-bordered and entire except a few of the elongated perichaetial, which are slightly serrulate near apex. It is undoubtedly closely related to *nutans*, differing chiefly in the

slender, elongated stems and more entire leaves. Some of the perichaetial leaves are only $\frac{1}{3}$ mm. wide and up to $3\frac{1}{2}$ mm. long, without teeth, the margin being slightly sinuate only toward apex. These specimens agree in inflorescence and in every other way with specimens from Greenland, and labeled *sphagnicola* apparently in Schimper's own handwriting. Some half dozen other specimens in the "Garden" collection from Europe and labeled *sphagnicola* are very different plants (647).

Pohlia commutata Lindb. (*Webera commutata* Schimp.) Lake Lindeman. On sandy bank by stream. This species may usually be distinguished from our other *Weberas*, I believe, by the comparatively broad, short leaves, ovate rather than lanceolate, mostly 1–4, excepting a few perichaetial, the only other species approaching it in this respect being *cucullata*, which is paroicous (645).

Pohlia gracilis Lindb. (*Webera gracilis* De Not.) On shaded, moist sand bank of the Klondike River just above Dawson. The specimens are not fruiting but bear abundant red bulbs in the axils of the leaves, often 4 or 5 on the same stem. The bulbs measure about .260 by .375 mm. and are readily observed at some distance by the naked eye. They are borne on a very short stalk that comes out from the stem some little distance above the attachment of the leaf (646).

Pohlia proligera Lindb. (*Webera proligera* (Lindb.) Kindb.) Lake Lindeman in marshy place. A dioicous, very pale-colored plant, with elongated, spindle-shaped, more or less vermicular brood-bodies, clustered in the axils of the leaves. These bodies are quite variable in size and shape. They usually consist of several series of cells somewhat twisted together but apparently always terminating in a single pointed cell and measure about .020 by .200 mm., or even larger. The median leaf-cells are about .120 by .008 to .010 mm. (803).

Bryum arcticum B. & S.* Dawson, on earth in rather dry

* The *Bryums* have all been submitted to M. Philibert for determination and he has indicated several new species, the descriptions of which, however, have been drawn up by the author.

places. The outer plates of the teeth are often nearly square and up to .020 mm. high. The lamellae, about 16, are usually connected below by cross walls, not more than one, however, between adjoining lamellae. The spores in these specimens measure up to .028 or .030 mm. Upper leaf-cells large, up to .025 by .070 mm.

Bryum Brownii B. & S. ? (*Pohlia bryoides* R. Br. ?) Dawson, on earth about ledges of rock. There seems to be some confusion with regard to this plant. My specimens are called a variety, "*piliferum*" by M. Philibert, but they are scarcely or not longer pointed than is shown in Fig. 8a, Tab. Supp. I, IV., Bryo. Eur. The peristome as figured in this plate, also, as far as it goes, rather agrees with my specimens, viz., the lamellae are not very numerous (14 to 16) or close together and the outer plates are comparatively high. This does not agree with Limpricht's description, who states that the lamellae are numerous and close together and basal plates narrowly rectangular (1 to 4), also that the costa of the leaf is excurrent into a short awn. In the Dawson specimens the 14 or 15 lamellae are joined by 1 to 3 thick cross walls between the adjacent lamellae and the outer plates are from twice wider than high to nearly square. In a packet in the Columbia Herbarium, are European specimens called *Brownii* from Chr. Kaurin, but the lamellae are not connected by vertical walls and the plants are otherwise different so that they certainly are not *Brownii*. The same may be said of Bourgeau's specimens of "The Palliser N. A. Expedition; that is, unless true *Brownii* belongs to a section that does no have the lamellae connected by cross walls as in *pendulum*.

The Dawson specimens are synoicous and antoicous, leaf border of one layer of cells not more thickened than within, spores roughened, up to .028 mm., leaf-cells below sometimes pitted (581).

Since writing the above Mrs. Britton has received a letter from Ernest S. Salmon, in which he gives good reasons for believing that the type of *Pohlia bryoides* R. Br., is not in existence. Taking, then, Schimper's figures in the Bryologia

Europea as representing the type of *B. Brownii*, it would seem that the only differences by which this is to be distinguished from *pendulum* (*B. cernuum*), Plate 331, are the better developed cilia and the thin, not pitted leaf-cells. We have lately received from M. Philibert a specimen collected in Norway and regarded by him as true *Brownii*. This shows teeth with about 23 lamellae joined by very thin cross walls, the outer plates toward base $1\frac{1}{2}$ to $2\frac{1}{2}$ times wider than high and 2 or 3 cilia, not appendiculate and irregular, some of them nearly as long as the segments. Roughened spores up to about .030 mm. Flowers antoicous, ♂ and ♀ very similar, but the first rather larger. The leaf-cells are thin-walled, the lower being longer in proportion to width (from 3 to 6 to 1) than in *pendulum*, in which they are nearly square, often, in basal angles. The stem leaves are nearly all worn away and imperfect; a few, however, show points nearly as long as Schimper's figure. In any case my Dawson specimens must be referred to *pendulum* and the others mentioned above, except the one from Norway, are not *Brownii*, nor is Drummond's no. 265, so there seems to be no known American specimens at present.

Bryum pendulum (Hornsch.) Schimp. Dawson, in fine fruit July 30. Inflorescence, teeth, etc., as given for the preceding Dawson specimens (582).

Bryum Dawsonense R. S. Williams, sp. nov.

Synoicous and autoicous. Tufts low, 1.5 cm. high, and dense. Stems branching. Outer perichaetial leaves ovate-lanceolate, upper stem leaves ovate, about 2.5 mm. long with costa excurrent the length of 2 or 3 short cells. Lower stem leaves much smaller and costa not quite percurrent. Leaves entire, or sometimes minutely serrulate towards apex with revolute margins from base to near apex or in very young or lower leaves margins scarcely revolute. Marginal cells $\frac{1}{2}$ down in upper leaves narrowed and much elongated in 3 or 4 rows but only slightly changed toward apex. Inner perichaetial leaves small, lanceolate pointed, with percurrent costa. Median leaf-cells rhomboidal to hexagonal, mostly 2 or 3 times longer than broad, about .050 mm. long. Lower

cells sometimes pitted. Capsule with lid up to 2.5 mm. long. Sporangium oblong, scarcely or not contracted below mouth and rather abruptly narrowed when dry to the shorter collum. Peristome yellowish below, the lower plates of teeth mostly twice wider than high, gradually becoming nearly square above; lamellae 16–18, irregularly connected by 1–3 cross walls between adjoining lamellae; segments narrow and narrowly perforated, separated by mostly 2 cilia, a little shorter and often long appendiculate. Annulus broad, of 3 rows of cells. About 3 rows of transversely elongated cells about mouth of capsule, the cells near middle becoming somewhat rectangular and in collum scarcely elongated and sinuous walled, with oblong stomata about .040 mm. long. Spores smooth or nearly so, up to .025 mm. (Plate 17.)

Dawson, on damp earth. In good fruit Aug. 28, 1898. This plant is undoubtedly close to *pendulum* differing in the short pointed leaves, more distinctly bordered and in the long cilia, some of which are finely appendiculate (585).

M. Philibert left me in doubt as to just what he considered this plant and I have finally ventured to describe it as a distinct species rather than a variety of *pendulum*.

Bryum longisetum Bland. Dawson. In good fruit July 31, on swampy ground with *Meesea uliginosa*. These specimens have a seta up to 8.5 cm. high. The teeth are small with only about 12 lamellae not joined by cross walls, the dorsal plates high (about 1 to 2). Inner peristome free with narrow segments and very short cilia. Spores large and nearly smooth, up to .040 mm. Leaves long-pointed, costa excurrent for a length of 4 or 5 cells (649).

Bryum conditum R. S. Williams, sp. nov.

Dioicous. Male plants discoid. Tufts up to 3.5 cm. high. Stems and branches more or less radiculose. Outer perichaetial leaves oblong-lanceolate, with a gradually narrowed base, up to 4.5 mm. long. Upper stem leaves a little shorter with broader base, all entire, with costa excurrent for a length of 3 or 4 cells and a brown revolute border of thick-walled cells in double layer, confluent with the costa. Lower stem leaves much smaller with costa vanishing. Inner perichaetial leaves very broad, the width very often equal to $\frac{1}{2}$, or more, of the length and costa percurrent.

Median leaf-cells mostly hexagonal, 2 to 4 times longer than wide, up to .070 mm. long. Cell walls rather thick, scarcely pitted or sometimes distinctly so both above and below. Capsule with lid up to 5.5 mm. long. Sporangium not contracted below mouth, mostly somewhat gradually narrowed to collum and about equalling it in length. Lid low-convex, not mamillate. Annulus of 3 or 4 rows of cells. Exostome pale golden-yellow below with dorsal plates near base 3 to 4 times wider than high and 26 to 28 lamellae on ventral side not joined by cross walls. Endostome free, with basal membrane extending $\frac{1}{2}$ up, segments broadly pointed with 8 to 10 narrow perforations, well developed cilia broad, solitary, 2 or 3 rows of cells wide, with apex sometimes slightly split or shorter and imperfect. About three rows of transversely elongated cells about mouth of capsule, the cells toward middle becoming rectangular (3 or 4 to 1) and near base short and irregular with oblong stomata about .040 mm. long. Spores smooth, up to .024 mm. (Plate 18.)

On rocky hillside between Cañon City and Sheep Camp, on Dyea Creek, March 28, 1898. This plant comes nearest *uliginosum*, I believe, but differs in the more pointed leaf with more distinct and revolute border, pitted leaf-cells, blunt lid, more developed inner peristome and dioicous inflorescence (578).

This plant was wholly unnamed by M. Philibert, and I should have been greatly pleased to have given his name to the species, but it does not seem to be available in this connection.

Bryum cuspidatum Schimp. Dawson. This species has the costa excurrent into a sharp, denticulate point 4 or 5 cells in length, a revolute margin of narrow cells, dorsal plates of exostome 2 or 3 times wider than high, 25 or more lamellae on ventral surface and smooth spores up to .014 mm. (586).

Bryum caespiticium L. Marsh Lake. In good fruit June 10 (658).

Bryum Duvalii Voit. Sterile specimens collected at the head of Lake Bennett (652).

Bryum ventricosum Dicks. (*B. pseudotriquetrum* (Hedw.) Schwaegr.) Skagway. In fine fruit August 27, on wet rock (807).

Bryum ventricosum compactum (B. & S.) Williams.

(*B. pseudotriquetrum compactum* B. & S.)

Dawson, July 17, in fine fruit. A much smaller plant than the species, in very compact tufts. The leaf-cells and spores seem to be rather smaller also. The medium cells measure .008 mm. wide and .016 to .025 mm. long, the spores up to .014 mm. The dorsal plates of teeth are rather narrow, about 1 to 3 near base, lamellae 30. Cell walls of the leaves usually seen to be distinctly pitted under a magnification of 300 dia. or more (583).

Bryum submuticum Philibert, sp. nov.

Dioicous. Male flowers bud-like with leaves ovate and more or less spreading but not reflexed near middle, abruptly much smaller on stem below. Plants growing in extensive mats 2 or 3 cm. thick, stems scarcely branched, felted together with a dense mass of radicles below. Outer perichaetial leaves $2\frac{1}{2}$ mm. long, ovate, somewhat acutely pointed with costa percurrent or excurrent the length of 1 or 2 short cells, upper stem leaves a little shorter and costa vanishing just below apex, all entire or nearly so with a distinct revolute border of about 3 rows of long narrow cells near middle, towards apex the margins flat and cells not much elongated. Inner perichaetial leaves ovate-lanceolate with costa vanishing just below apex. Median leaf-cells about .035 mm. long and $\frac{1}{2}$ as broad, lower cells short rectangular (about $1-1\frac{1}{2}$ or 2). Cell walls all somewhat thickened but not pitted. Capsule with lid up to $2\frac{1}{4}$ mm. long, slightly narrowed under the mouth, the sporangium gradually narrowed to a shorter collum. Exostome pale yellow below. Plates of teeth narrow (about 1–3) near base, lamellae from 25–30. Basal membrane of endostome extending $\frac{1}{2}$ up, the segments broadly perforated and separated by mostly 3 appendiculate cilia. Two or 3 rows of transversely elongated cells about mouth of capsule, the cells near middle broad, often scarcely elongated with somewhat sinuous walls, at base very irregular and sinuous walled. Oblong stomata about .035 mm. long. Smooth spores up to .014 mm. Annulus of 4 rows of cells. (Plate 19.)

This species is quite near the preceding variety but still smaller and more slender. The leaves are broader, shorter

pointed, more entire, and costa more frequently vanishing just below point (584).

Collected in good fruit July 17, 1899, at Dawson, also at the mouth of the little Salmon River. The plants form extensive mats, often many feet across, in low, wet places.

Bryum suborbiculare Philibert, sp. nov.

Apparently dioicous, no male flowers found. Tufts up to $2\frac{1}{2}$ cm. high. Stems seldom branching. Leaves in 3 or 4 rosettes with innovations starting from their bases. Outer perichaetial leaves oblong, somewhat acutely pointed, 2 mm. long, upper stem leaves a little shorter, very broadly ovate, often obtuse, all entire with costa percurrent or mostly so. Borders revolute below and of about 3 rows of elongated cells, toward apex becoming flat and cells scarcely elongated. Lower leaves small, obtuse, often nearly as broad as long, with costa vanishing. Inner perichaetial leaves very broadly ovate-lanceolate, small, with costa vanishing. Median leaf-cells rhomboidal to hexagonal, from scarcely elongated to twice longer than broad, up to .025 mm. long. Cell walls not pitted. Capsule with lid up to 3 mm. long, broadly obovate, the sporangium gradually narrowing to a very short collum. Lid low-convex, papillate. Seta up to $2\frac{1}{2}$ cm. high. Exostome with lower dorsal plates narrow (1–3) and 25–30 lamellae on inner face. Endostome free with basilar membrane extending over $\frac{1}{2}$ up, the segments slender above and widely perforate with mostly 3 long, finely appendiculate cilia between. Annulus of 3 rows of cells. Exothecal cells about mouth of capsule transversely elongated, in 2 or 3 rows, near middle the cells about twice longer than wide, toward base irregular, sinuous walled, with stomata about .035 mm. long. Spores nearly or quite smooth, up to .016 mm. (Plate 20.)

This small moss is peculiar in having the broad, mostly obtuse leaves clustered in 3 or 4 rosettes along the stem. It does not seem to be related very closely to any other American species.

Dawson, growing in swamp with *Cinclidium* and apparently rare. Collected in good fruit, July 2, 1899 (577).

Plagiobryum Zierii (Dicks.) Lindb. (*Zieria julacea* Schimp.) A few sterile specimens collected on earth in crevices of rock about 1000 ft. above Lake Lindeman (660).

Plagiobryum argenteoides R. S. Williams sp. nov.

With the appearance of *Bryum argenteum*. In dense tufts up to 1 cm. high. Stems simple or branching, vineous red, radiculose below, in cross section showing an outer wall of one layer of irregular, somewhat thick-walled cells, with ground tissue of very large, thin-walled cells, becoming smaller toward center and enclosing a distinct central strand. Leaves concave, appressed, broadly ovate, with short abrupt point, entire, mostly $\frac{1}{2}$ mm. long or less or occasionally the terminal leaves lanceolate pointed and up to 1 mm. long. Costa vanishing from $\frac{1}{3}$ to $\frac{2}{3}$ up. Upper $\frac{1}{3}$ of leaf usually hyaline. Alar cells and most basal cells square (sides 12 to 16 mm.) to short rectangular (1 to 2). Median cells irregularly rhomboidal to oblong-linear, up to .040 or .050 mm. by .012 mm. Cell walls somewhat thickened, especially above. (Plate 21.)

This species is distinguished from the preceding by its small size and nerve vanishing far below the apex as well as by the short, square alar cells. Found on bare rock in dry places on the Yukon River, just below Dawson, March 19, 1899 (659).

Karl Mueller described in Flora, 70: 221, 1887, a *Bryum bullatum*, which he compares with small *Plagiobryum Zierii*. As this comparison well fits my plant I was in some doubt as to the two being distinct, but having lately received a specimen of *bullatum* from the Mueller collection, through the kindness of the Berlin authorities, the two plants prove to be perfectly distinct, *bullatum* being an *Anomobryum* (*Sclerodictyon*) as described.

Mnium medium B. & S. Left bank of the Klondike River just below Bonanza Creek, not common, also collected at Skagway, growing abundantly under the heavy evergreen forests. Cell walls thickened and pitted, cells somewhat elongated, not in oblique rows, stomata immersed (661).

Mnium rugicum Laur. Head of Lake Bennett. In these specimens the leaf-cells are somewhat obliquely elongated but not in rows. The leaves are narrow at base, not decurrent and without distinct rectangular basal cells, the margin with very small irregular teeth or entire (662).

Mnium serratum Schrad. Klondike River near mouth of Bonanza Creek. In fine fruit, June 18. The leaves are long-decurrent, median cells up to .025 mm. (663).

Mnium orthorrhynchum Brid. Dawson. In good fruit, July 16. Leaves somewhat decurrent, occasionally long-decurrent. Median leaf-cells up to about .016 mm. (664).

Mnium spinulosum B. & S. Lake Lindeman (665).

Mnium cinclidioides (Blytt.) Hueben. Dawson (666).

Mnium Blyttii B. & S. Dawson. The sterile specimens referred here were growing in dense tufts up to 5 cm. high. The lower stem leaves are very broad and obtuse with mostly an entire border of one row of cells somewhat elongated and often nearly disappearing toward apex. The upper leaves are longer with a distinct border extending to a short pointed apex and usually bearing a double row of short, blunt teeth. Leaf-cells somewhat thickened, not pitted, scarcely elongated, up to .020 mm. Costa smooth on the back, vanishing 5 or 6 cells below the leaf point. Leaves scarcely or not decurrent. *M. Blyttii* usually has rather long-decurrent leaves (667).

Mnium punctatum elatum B. & S. Lake Lindeman (668).

Mnium subglobosum B. & S. Lake Lindeman. This species seems to constantly differ from the preceding in its inflorescence and peristome. The teeth of the latter are only about $\frac{2}{3}$ as large as in *punctatum*, most of the dorsal plates are nearly as high as wide and the lamellae are distant and only 12 or 14 in number (669).

Mnium hymenophyllum B. & S. Bennett City and Dawson. Growing in large, thick tufts in damp and shady or wet places. This species is very near *M. hymenophylloides*. It was removed to *Cinclidium* by Lindberg, and Limpricht has also placed it there. The only collection cited by the latter is "Rabenhorst, Bryoth. Eur. No. 246," which is, at least in the Columbia University set, not this plant but undoubtedly *hymenophylloides*. The only true European specimens of *hymenophyllum* examined are labeled "*M. hymenophyllum.* Herjedalen. Un. itin. cr. 1867. Hellbom (41 et 42)."

They correspond well with the description and figures in the Bryologia Europaea and my specimens from the Yukon are the same. The species may be distinguished from *hymenophylloides* by the more decurrent leaves, with more rounded apex and by the much shorter, wider cells in margin on either side just below the apex. The first 2 or 3 cells on either side of apical cell of leaf are scarcely elongated, the next 2 or 3 are rhomboidal, 2 or 3 times longer than wide, the width being .020 to .025 mm. In *hymenophylloides* the second or third cell in margin below the apical cell is about .010 mm. wide and 6 to 10 times longer than wide (673).

Cinclidium stygium Swartz. Dawson. Common in swampy places. In fine fruit July 9. The clear, rich red border of the leaves at once distinguishes this plant from any *Mnium*. The margins are mostly flat and of a single layer of thick-walled cells. The leaf-cells are obliquely elongated, somewhat in rows, the inner median up to .050 mm. long. Cell walls more or less thickened and pitted (671).

Cinclidium subrotundum Lindb. Head of Lake Bennett about springs. Tufts up to 9 cm. high. The leaves are very similar to the preceding but have a double layer of cells in the border (672).

Aulacomnium palustre (L.) Schwaegr. Mouth of the Little Salmon River. Fruiting, June 16 (675).

Aulacomnium palustre imbricatum B. & S. Dawson, very common in wet places. Plants about the size of *turgidum* (676).

Aulacomnium turgidum (Wahl.) Schwaegr. Sheep Camp, Dyea Creek, sterile. Dawson, very abundant, fruiting (677).

Timmia cucullata Michx. Yukon River just above Dawson. Growing at the base of trees. This species is quite distinct from *megapolitana*. It occurs in Montana and appears to be the commonest species of the genus in the eastern United States. It differs from *megapolitana* in the wider mouthed capsule, more curved and smooth when dry, the exothecal cells, also, are elongated and not sinuous walled, the stomata roundish, about .048 mm. in diameter, sometimes even

slightly elongated at right angles to the opening and the leaves are rather larger and wider above with larger cells and leaf base narrower (679).

Timmia megapolitana Hedw. Marsh Lake and Klondike River near mouth. This species seems to grow mostly on rather dry earth at the base of rock ledges, usually at a somewhat higher elevation than the preceding. The capsule is nearly straight and furrowed when dry, the exothecal cells sinuous-walled and not elongated, the stomata oblong to roundish, up to .072 mm. long and the leaf-base is usually wider than above (678).

Timmia Austriaca Hedw. Cañon City, Dyea Creek and Moose Creek just below Dawson. This species has the leaf-cells somewhat angular above, as compared with the two preceding species and vein more or less toothed dorsally toward apex (680).

Psilopilum arcticum Brid. Left bank of Klondike River just below Bonanza Creek. On damp black soil of hillside. Not fruiting (682).

Pogonatum alpinum (L.) Roehl. Sheep Camp, Dyea Creek and Lake Lindeman (683).

Polytrichum gracile Dicks. Yukon River just below Whitehorse Rapids (684).

Polytrichum piliferum Schreb. Lake Lindeman (685).

Polytrichum hyperboreum R. Br. Lake Lindeman. This plant has a white hair-point like the preceding, but grows up to 8 cm. high or more, with abundant branches. The hyaline lower cells average somewhat narrower and about twice longer than in *piliferum*. They are .008 to .012 mm. wide and up to .160 mm. long (686).

Polytrichum juniperinum Willd. Lake Lindeman (687).

Polytrichum strictum Banks. Sheep Camp, Dyea Creek, and Lake Lindeman (688).

Polytrichum commune L. Lake Lindeman and Dawson. At the latter place in fine fruit July 30 (689).

Polytrichum inconstans Hagen.

Stems slender, up to 8 cm. high, rather uniformly leaved

above with a felt of dark red radicles below. Leaves somewhat distant, irregularly spreading, up to 6 mm. long, lanceolate with costa scarcely or short excurrent and margins minutely serrulate. Lamellae up to about 24, the median from 5 to 9 cells high, terminating in 1 or sometimes 2 cells, transversely oblong in section, about twice wider than high and not or scarcely depressed. Blade of leaf-bearing lamellae on either side of costa of only two layers of cells thick with cell walls on back of leaf not thickened. Leaf-cells in blade between base of lamellae and margin of leaf mostly from .012 by .016 mm. to .016 by .020 mm. (Plate 22.)

These specimens have been compared with specimens of *inconstans* Hagen in litt., collected by C. Jensen at Lilleelvedal, Norway, lately received from Harold Lindberg, fil., and are without doubt the same. The species is peculiar in the broad terminal cell of the lamellae, often doubled, the thin cell walls on back of leaf, very small teeth of margin and short excurrent nerve.

Collected at Lake Lindeman, in swampy places, May 26, 1898 (690).

Dichelyma falcatum (Hedw.) Myrin. Lake Lindeman. On wet banks. In fine fruiting tufts up to 11 cm. high (692).

Neckera Menziesii Drumm. Cañon City, Dyea Creek (695).

Neckera pennata (L.) Hedw. Sheep Camp, Dyea Creek. On cotton-wood (694).

Neckera pterantha C. M. & K. Dawson. In crevices of rock. Fruiting abundantly. Secondary stems scarcely branching. Paraphyllia abundant or almost wanting (693).

Pterigynandrum filiforme Hedw. Sheep Camp, Dyea Creek. On trees (696).

Pterigynandrum filiforme decipiens (Web. & Mohr.) Limpr. Lake Lindeman. On rock. This variety is darker colored and grows in larger, looser tufts than the species with the tips of the stems and branches more curved (697).

Antitrichia curtipendula gigantea Sulliv. & Lesq. Dyea Creek, on trees. Skagway, on rock. All sterile (698).

Antitrichia Californica Sulliv. Dyea, Dyea Creek. Fruiting (802).

Myurella julacea (Vill.) B. & S. Head of Lake Bennett. On rock, sterile. Dawson, about roots of trees in damp places. In fine fruit, April 23 (700).

Myurella apiculata (Hüben.) B. & S. Dawson. On earth at foot of rock ledges, in fruit (699).

Leskea tectorum (A. Braun) Lindb. Lake Lebarge and Dawson. On rock in rather dry places. Determined by Dr. G. N. Best. This species has smooth, broadly ovate leaves, with short-lanceolate point. The leaves are very concave, entire, with margin flat above and recurved below. The leaf-cells are mostly oval to rhomboidal, seldom more than twice longer than broad and in margin below slightly transversely elongated. The vein is broad below and extends $\frac{1}{2}$ up the leaf or sometimes shorter and forked above. Sterile (702).

Pylaisia polyantha (Schreb.) B. & S. Sheep Camp, Dyea Creek, on wood. Dawson, at base of trees and on rock. Abundant and fruiting (703).

Entodon orthocarpus (La Pyl.) Lindb. (*Cylindrothecium concinnum* Schimp.) Island about 10 miles below Ft. Selkirk. On ground under heavy spruce forest. This species has before been reported only from Colorado and Newfoundland in North America. It is so like a slender form of *H. Schreberi*, however, that it must have been largely overlooked in this country. The hyaline cluster of rather small alar cells is sometimes as much as 4 layers of cells in thickness (789).

Climacium dendroides (L.) Web. & Mohr. Cañon City, Dyea Creek, Marsh Lake and Klondike River bottom near mouth. Not found fruiting (705).

Climacium dendroides Oregonense R. & C. Shore of Lake Marsh, on gravel, sterile (706).

Holmgrenia chrysea (Schwaegr.) Lindb. (*Orthothecium chryseum* B. & S.) Skagway and Lake Bennett (707).

Pseudoleskea radicosa (Mitt.) Lesq. & James. Lake Lindeman (656).

Pseudoleskea pallida filescens Best. Head of Lake Bennett (706).

Pseudoleskea substriata Best. Lake Lindeman, on rock along shore (657).

Heterocladium procurrens (Mitt.) Rau & Hervey. (*Heterocladium aberrans* Ren. & Card.) Skagway and Cañon City, on rock (708).

Thuidium recognitum (Hedw.) Lindb. Yukon River above Ft. Selkirk and common about Dawson. Not fruiting (709).

Thuidium Philiberti (Philib.) Limpr. Klondike River bottom near mouth. Sterile. The leaves have a smooth hair-point up to 6 cells in length, the median leaf-cells near costa are up to .008 or .010 mm. in length being about twice longer in *recognitum*. Also the papillae are shorter, the leaf margins smoother, and the cells more angular with thinner walls than in the latter species (710).

Thuidium abietinum (L.) Br. & Sch. Tagish Custom House; also common about Dawson on earth and rock (711).

Thuidium Blandovii (Web. & Mohr) Br. & Sch. At head of Lake Bennett also near mouth of Bonanza Creek, in fine fruit July 9 (712).

Claopodium pellucinerve (Mitten) Best. Cañon City, Dyea Creek. Determined by Dr. G. N. Best. A notice of this plant has already appeared in the Bryologist, 3: 20, 1900. It is a very slender species with ovate-lanceolate leaves, the surface densely and minutely papillose and leaf-cells obscure except in the smooth, slender point (655).

Camptothecium lutescens (Huds.) B. & S. Sheep Camp, Dyea Creek. On cotton-wood. In these specimens the vein of the leaf never seems to end in a spine as in European specimens (713).

Camptothecium nitens (Schreb.) Schimp. Lake Lindeman, sterile. Mouth of Little Salmon River, in fruit. Dawson, common and fruiting abundantly. Capsules in fine condition June 18 (715).

Camptothecium Nuttallii B. & S. Skagway (714).

Brachythecium salebrosum (Hoffm.) B. & S. Lake Lindeman and Dawson (716).

Brachythecium salebrosum densum B. & S. Mouth of

Little Salmon River. I refer specimens here with rather narrower leaves more closely placed on stems and branches than in the preceding (717).

Brachythecium albicans (Neck.) B. & S. Skagway, on rock. Sterile (797).

Brachythecium Starkei (Brid.) B. & S. Lake Lindeman. In these specimens the costa extends about $\frac{2}{3}$ up or is shorter and double (719).

Brachythecium reflexum Starke. Lake Lindeman (718).

Brachythecium Idahense R. & C. Dawson, on earth and rock. This species is evidently most closely related to *collinum* from which it is distinguished principally by the narrower leaves. The costa of the leaves near the ends of the branches terminate in a spine, with the leaf surface on either side papillose by the projecting upper ends of the cells. This roughening of the back of the leaf occurs in *collinum*, but to a less degree and it makes these two species close to those of *Bryhnia*, or rather, brings those species almost too close to *Brachythecium*, it would seem. The perichaetial leaves of both *collinum* and *Idahense* are somewhat variable, usually rather abruptly acuminate with one or two coarse teeth at base of acumen (720).

Brachythecium petrophilum R. S. Williams sp. nov.

In low, dense tufts or sometimes in thin mats with long creeping stems and short subpinnate branches. Stem leaves 1.5 mm. long by .4 mm. wide, narrowly ovate-lanceolate, about one-half costate, serrulate all round, more or less decurrent and margin reflexed near base, not very concave and scarcely or not plicate. Median leaf-cells linear flexuous up to .065 mm. long and .005 mm. wide. Alar cells short and broad not forming a distinct cluster. Branch leaves very similar to stem leaves but mostly a little smaller, with longer costa ending in spine on back and adjacent cells sometimes papillose by the projecting upper ends. Inner perichaetial leaves pale, ecostate, gradually narrowed to a slender, flexuous, serrulate point, with rarely 1 or 2 coarse teeth at its base. Capsule nodding, curved, with lid about 2.5 mm. long and 1 mm. broad. Lid conical, its height about equal to basal di-

ameter. Annulus of two rows of cells. Teeth of peristome hyaline bordered, papillose above, outer plates striate, inner lamellae about 30, segments without rounded perforations, more or less split along the keel with mostly 2 appendiculate cilia between. Seta rough throughout, up to 1.2 cm. high. Smooth spores up to .011 mm. (Plate 23.)

Dawson, on rock. In good fruit June 24, 1898 (722). This species is evidently nearest *suberythrorrhizon* but differs in the rough pedicel, leaves narrower, less serrate and plicate and cilia appendiculate.

Brachythecium erythrorrhizon B. & S. Dawson, on earth, common. Leaves always more or less falcate-secund, thus resembling *velutinum* more perhaps than any other of the genus (721).

Cirriphyllum cirrosum (Schwaegr.) Grout. Skagway. In thick mats on rock by stream. Collected in rather old fruit, August 27. These specimens have stems up to 11 cm. long. A few of the capsules still retain the lid which is acutely conical, a little higher than its basal diameter. The segments are separated by 1–3 long, nodose cilia. Not before reported with fruit in North America (794).

Eurhynchium strigosum (Hoffm.) B. & S. Dawson, common (725).

Eurhynchium stoloniferum (Hook.) Jaeger & Sauerb. Cañon City, Dyea Creek and Skagway (724).

POROTRICHUM NECKEROIDES (Schwaegr.) Williams.

(*Thamnium neckeroides* B. & S.)

Cañon City, Dyea Creek. Lower stem leaves nearly as broad as long, entire or nearly so, with rounded apex. Costa rather coarsely toothed above on back in the upper leaves (726).

Plagiothecium piliferum (Sw.) B. & S. (*Hypnum trichophorum* Spruce.) Skagway, Cañon City and Lake Lindeman. In very soft, often thick cushions on rock (727).

Plagiothecium pulchellum (Dicks.) B. & S. Lake Marsh and Dawson. Common on earth and rock (728).

Plagiothecium denticulatum (L.) B. & S. Head of Lake Bennett and Dawson (729).

Amblystegium filicinum (L.) De Not. (*Hypnum filicinum* L.) Head of Lake Bennett, in springs (747).

Amblystegium Sprucei (Br.) B. & S. Dawson, in good fruit, August 7 (733).

Amblystegium compactum (C. Muell.) Aust. Dawson. Common (734).

Hypnum hispidulum Brid. Dawson, on logs. In fruit, July 16. These specimens have the perichaetial leaf rather short pointed and cilia only occasionally appendiculate (732).

Hypnum chrysophyllum Brid. Dawson (736).

Hypnum stellatum Schreb. Head of Lake Bennett and Dawson (737).

Hypnum polygamum (B. & S.) Wils. Klondike River bottom (738).

Hypnum uncinatum Hedw. Cañon City, Dyea Creek, Lake Lindeman, Lake Lebarge and Dawson (744).

Hypnum uncinatum plumulosum Schp. Lake Lindeman, among boulders in rather dry places (799).

Hypnum fluitans L. In swamps near Marsh Lake. These specimens have leaves minutely serrulate all round, scarcely decurrent or very narrowly so at angles with costa from .050 to .060 mm. wide at base (about $\frac{1}{5}$ width of leaf base) and extending $\frac{3}{5}$ up. Median cells .006 mm. wide and up to .130 mm. long. Cross section of stem shows 2 or 3 rows of thickened cells in outer wall and a slightly developed central strand (798).

Hypnum Wilsoni Schimp. Middle of Lake Lebarge. The specimens I refer here are rather short (7 cm. high) with leaves a little narrower and less recurved than in typical specimens from Southport, Eng. The Yukon specimens are more like the specimens figured by Limpricht. All the specimens have leaves with very long, slender, flexuous or twisted points and scarcely decurrent angles. Sections of stem show 3 or 4 rows of thick-walled, golden-yellow cells next the surface and a central strand not always very distinct (740).

Hypnum revolvens Swartz. Dawson, common in swamps.

Sections of stem show at the surface a layer of thin-walled cells next to several rows of thickened cells and mostly a central strand of 4 or 5 small cells, sometimes not distinct, however. The costa is in section plano-convex. Plates of teeth finely cross-lined (745).

HYPNUM AMBLYPHYLLUM R. S. Williams sp. nov.

Dioicous. Growing in water up to 3.5 dm. high, with mostly short, subpinnate branches hooked at apex. Cross sections of stem 5-sided with distinct angles, a poorly developed central strand of 3 or 4 small cells and outer walls of 1 or 2 rows of thickened cells. Leaves below more or less spreading, flexuous and twisted, toward the tops of the stems and branches falcate-secund with the tips often abruptly incurved. Stem leaves about 2.25 mm. long, serrulate all round, distinctly long-decurrent, ovate-lanceolate with broad, obtuse point, not plicate, somewhat concave, especially toward apex. Costa extending $\frac{2}{3}$ up, slightly convex on back. Alar cells often inflated nearly to costa and some small, nearly quadratic cells at margin just above the alar cells. Medium leaf-cells .005 or .006 mm. wide and mostly .035 to .060 mm. long. Younger branch leaves narrowly lanceolate with very short costa. Perichaetial leaves not plicate, closely sheathing, but little larger or more pointed than stem leaves, entire, with faint costa extending up $\frac{2}{3}$ or more. Seta up to 6 cm. long. Capsule 2.5 by 1 mm., with short upright collum, but much curved and nodding above. Lid acutely conical, its height less than basal diameter. No annulus. Peristome teeth broadly hyaline bordered above, outer plates finely punctate below. Basal membrane of endostome scarcely $\frac{1}{2}$ the teeth in height with solid segments and 2 or 3 nodose cilia between. Transversely elongated cells about mouth of capsule in 3 or 4 rows, the cells below roundish to oblong. Stomata roundish to short oblong, up to .040 mm. long. Minutely roughened spores up to .016 mm. (Plate 24.)

This species is intermediate between *exannulatum* and *pseudostramineum*. From the first it differs in the short, broadly-pointed leaves, the angular stem with fewer thickened cells in the outer walls and leaf-cells not pitted. The second differs in being monoicous, with entire, not decurrent leaves and not angular stems.

Dawson, in swamp water, in fine fruit July 17, 1898 (746).

Hypnum falcatum Brid. About springs at head of Lake Bennett. Leaves nearly entire or serrulate slightly below. Median cells about .004 mm. wide and .030 to .060 mm. long and cell walls all thickened (748).

Hypnum crista-castrensis L. Lake Lindeman and Klondike River bottom. Not found in fruit (750).

Hypnum reptile Michx. Dawson, on rock. Median leaf-cells .004 by .030–.040 mm., scarcely vermicular, alar cells short oblong to quadratic. Leaves not decurrent (756).

Hypnum hamulosum B. & S. Dawson. At base of trees in damp places. These specimens are rather more robust than usual with longer and more narrowly pointed perichaetial leaves. Cross sections of stem are oval, about .200 by .160 mm. This is smaller than given by Limpricht (.300–.350 mm. long), but no. 491, Raben. Bry. Europ., cited by him, shows sections similar to mine in every way. The thin outer cells of the stem have the exposed surfaces mostly sunken in or worn way giving the surface a rough, papillose appearance in cross section. The thickened cells next the outer wall are in 3 or 4 rows. Central strand distinct. The leaves are more or less plicate and border revolute below on one side (754).

Hypnum subplicatile (Lindb.) Limpr. Lake Lindeman, on damp rock and earth. This plant is very close to *callichroum* but differs in being rather smaller with regularly pinnate branches, leaves wider just above the base and abruptly narrowed to the insertion and capsule shorter. Cross sections of stem show an indistinct central strand and walls of a row of thin outer cells next about 3 rows of thick-walled cells. Median leaf-cells slightly vermicular, about .005 mm. wide and .040–.060 mm. long, alar cells mostly forming a small but distinct, convex, pale cluster. Stem leaves entire, borders flat, terminal branch leaves minutely serrulate, perichaetial leaves gradually narrowed to long, serrulate, slender point.

According to Limpricht this species has been previously col-

lected on the island of Sachalin and in eastern Russia (751).

Hypnum circinale Hook. Cañon City, Dyea Creek. In good fruit March 28, on trees. Common at Skagway on fallen logs. These specimens are dioicous with antheridial flowers more or less clustered on the stems. The annulus is simple, composed of pale cells slightly cohering. Median cells about .004 by .055 mm. Alar cells forming an inflated cluster. Spores rough, up to .016 mm. (752).

Hypnum revolutum (Mitt.) Lindb. (*H. plicatile* Mitt.) Lake Lindeman and Lake Marsh. Medium leaf-cells .005 mm. wide and up to about .040 mm. long, the majority of cells, however, up to .025 or .030 mm. long. Numerous short often nearly square alar cells with usually a few hyaline, somewhat enlarged cells in angles. In *cupressiforme* the median cells are about twice longer (757).

Hypnum cupressiforme brevisetum Schimp. Lake Marsh, on rock. The sterile specimens referred here possibly belong elsewhere, yet they come very close to this variety, differing principally from the species in the leaves being straighter, rather shorter and with somewhat shorter leaf-cells (758).

Hypnum Vaucheri Lesq. Dawson at base of tree. This species is dioicous. The leaves are entire, with flat borders. Cells in angles small, roundish or nearly square, extending up for a distance of 10 or 12 cells and in toward costa about the same amount. Median leaf-cells about .004 by .030 to .040 mm. (755).

Hypnum Lindbergii elatum Schimp. Lake Lindeman, in swamps. The specimens referred here have rather longer pointed leaves than the type with leaf-cells also longer and narrower, the median cells measuring about .004 by .080 mm. The stem leaves are entire, flat bordered, not decurrent with a convex cluster of more or less inflated alar cells, either pale or colored. Stem sections oval, .280 mm. long, the outer row of cells thin-walled, the next 2 or 3 rows thick-walled, with central strand well developed, of 10 or 12 small cells (761).

Hypnum pratense Koch. Dawson, on hummocks in swamp. Growing in depressed tufts with distichous leaves and the habits of a *Plagiothecium.* Stem leaves serrulate or nearly entire, branch leaves distinctly serrulate towards apex (730).

Hypnum palustre Huds. Skagway, Lake Marsh and Miles' Cañon. The cell walls are somewhat thickened and linear-vermicular, the median up to .040 mm. long and scarcely .004 mm. wide. Alar cells mostly forming a distinct cluster often more or less colored (765 and 767).

Hypnum Bestii Ren. & Bryhn. Skagway. This species attains a greater size, 15–20 cm., than any other of the *Limnobiums.* It has leaves secund, broadly ovate-lanceolate, with a blunt, slightly serrulate apex. The leaf-cells are rather irregular and thin-walled except at base, the alar cells somewhat gradually enlarged or 2 or 3 cells rather abruptly enlarged at the more or less decurrent angle. This plant is described as a subspecies of *molle* by Renauld and Bryhn, but I think it will stand as a distinct species. It differs from *molle* in having no central strand. It is a larger species, also, with stems below wiry and harsh with the bases of the broken-off leaves. At first glance it more resembles *dilatatum* but the latter has much broader, often almost circular leaves and a distinct, convex cluster of alar cells, as well as central strand (770).

Hypnum alpinum Schimp. Lake Lindeman. I have compared these specimens with no. 1348 Rabenhorst, Bryoth. Eur., the only collection cited by Limpricht, and they are undoubtedly the same; it may be questioned however, whether *alpinum* is at best anything more than a variety of *dilatatum* with slightly more serrulate leaves (771).

Hypnum alpestre Sw. Skagway and Lake Lindeman. These specimens have a rather broadly ovate, short-pointed leaf and costa forked near base, with both branches often extending to or above the middle. The leaf-cells are probably more uniformly elongated and narrowed, with thicker walls from base to apex than in any other *Limnobium.* In older

leaves the very distinctly inflated cluster of alar cells is apparently always more or less deep red, sometimes the whole base being colored or even the cell walls up to apex. Young leaves have alar cells hyaline. Median cells measure .005 mm. wide and up to .060 mm. long. The leaves are usually minutely serrulate all round (768 and 769).

Hypnum ochraceum Turn. Dawson, on rock in bed of stream. The stems of these specimens are rather slender and elongated, with leaves shorter and broader-pointed than in typical specimens. The hyaline alar cells are more decurrent, I believe, than any other species of the group. The outer wall of the stem consists of a single layer of large, thin-walled cells next several rows of thickened cells (772).

Hypnum polare Lindb. Lake Lindeman. Growing along low wet shore. This species is distinguished from any of our others by the ovate-oblong leaves, with stout nerve, very convex on the back, vanishing just below the apex and becoming as wide or wider above the middle than at the middle. Alar cells scarcely enlarged or forming a distinct cluster. The plant has been previously collected in several localities in Europe and also in Greenland (773).

Hypnum cordifolium Hedw. Klondike River bottom near mouth. I refer specimens here having scarcely branched stems, alar cells not forming quite so distinct a convex group as in the next and other leaf-cells perhaps a little wider, none of the assigned differences between this and *giganteum* seem very constant however (774).

Hypnum giganteum fluitans Klinggr. In still water of small stream flowing into Marsh Lake. These specimens are the largest I have seen, the leaves measuring 4.5 by 3 mm. The leaves on lower stem are distant, the branches mostly few, short and irregularly placed (775).

Hypnum sarmentosum Wahl. In small pond by snow banks about 1000 feet above Lake Lindeman (776).

Hypnum sarmentosum fontinaloides Berggrn. Bonanza Creek near mouth. On rocks in the bottom of a small stream. This is a variety with long, slender stems and

larger leaves often all green or partly green and partly purple. These specimens have the cell walls less thickened and pitted than in the species (777).

Hypnum Richardsoni (Mitt.) Lesq. & James. Dawson in swamps. In fine fruit July 27. This species is distinguished from *cordatum* and *giganteum*, the two most closely related, I believe, by the shorter nerve, extending only $\frac{2}{3}$ or $\frac{3}{4}$ up and often forking in the upper part. The perichaetial leaves are ecostate to faintly $\frac{1}{2}$ costate (778).

Hypnum Schreberi Willd. (*Hylocomium parietinum* (L.) Lindb.) Lake Lindeman and Dawson, not fruiting (779).

Hypnum stramineum Dicks. Lake Lindeman (780).

Hypnum turgescens (Jensen) Schimp. Just below Whitehorse Rapids in dried-up swamp. Growing in broad depressed mats (781).

Hypnum turgescens uliginosum Lindb. In swamps with the preceding. This variety has elongated stems and distant, more or less spreading leaves (782).

Hypnum badium Hartmann. On margin of pond just below snow banks about 1000 feet above Lake Lindeman, also at Dawson on wet, shady bank. From the remarks in Lesquereux & James' manual that "It is considered by Mueller to be a form of *H. revolvens*," one would suppose the leaves to be somewhat similar to that species, but in fact they are very distinct. The median leaf-cells are only about $\frac{1}{2}$ as long (.040 to .060 mm.), the cell walls are thicker except at the points where the rounded ends overlap, where they become very thin and the leaf is differently shaped. In *badium* the widest part of the leaf is near the middle and gradually tapers to a base only about $\frac{3}{5}$ as wide. Above the leaf tapers rather abruptly to a sharp point. In *revolvens* the leaf base is wider, the leaf above tapers gradually to a long, slender point and the basal cells are much less differentiated. In *badium* there are usually one or two rows of well-defined, enlarged, oblong cells at base with occasionally an almost inflated cluster in the angles. It is a plant of northern distribution, having been previously collected in Norway, Sweden, Greenland and Labrador (795).

Hypnum scorpioides L. (*Scorpidium scorpioides* (L.) Limpr.) Just above Lake Lindeman in blackish mats almost covering the bottom of a small pond 12 or 15 inches below the surface. The plants have the appearance of great age, most of the leaves being worn into shreds (783).

Hypnum scorpioides gracilescens Sanio. In dried-up swamp a few miles below White-horse Rapids, covering extensive areas with a mat up to 18 cm. thick. The stems are slender, with short, distant branches and leaves distantly placed (793).

Hylocomium proliferum (L.) Lindb. (*H. splendens* Hedw.) Lake Lindeman, Thirty-mile River and Dawson. An abundant species occasionally fruiting. Plants variable in size and color, the long stems sometimes scarcely branching (784).

Hylocomium Pyrenaicum (Spruce) Lindb. (*H. Oakesii* Sulliv.) Lake Lindeman, on rock (785).

Hylocomium squarrosum (L.) B. & S. Lake Lindeman (786).

Hylocomium triquetrum (L.) B. & S. Yukon River below Ft. Selkirk and Klondike River bottom near mouth. Not apparently very common (787).

Hylocomium loreum L. Cañon City, Dyea Creek and Skagway. Not observed on the Yukon River (788).

Hylocomium rugosum (Ehrh.) De Not. (*Hypnum rugosum* L.) Lake Marsh and Mile's Cañon, sterile specimens abundant. Dawson, not rare in fruit (794).

Description of Plates.

Camera lucida drawings reproduced without reduction.

PLATE 15. *Ditrichum giganteum.*

Figs. 1 and 2. Plants, natural size.
Fig. 3. Capsule enlarged.
Fig. 4. Perichaetium, × 9.
Fig. 5. Inner perichaetial leaf enlarged.
Fig. 6. Apex of stem leaf, × 285.
Fig. 7. Part of peristome and capsule, × 285.
Fig. 8. Marginal cells ½ down leaf, × 285.

Fig. 9. Upper stem leaf, × 12.
Fig. 10. Cells of basal angle, × 285.
Fig. 11. Part of annulus, × 285.
Fig. 12. Cells near middle of capsule, × 285.
Fig. 13. Perigonial leaf and antheridium enlarged.
Fig. 14. Stoma, × 285.

PLATE 16. *Bryobrittonia pellucida.*

Fig. 1. Plant about natural size.
Fig. 2. Upper stem leaf, × 8.
Fig. 3. Lower stem leaf, × 8.
Fig. 4. Cross section of leaf, × 160.
Fig. 5. Cross section of stem, × 160. *a*, section of costa at point where it joins stem; *b*, a radicle growing out from stem; *c*, lower part of costa where it is wholly adnate to stem.
Fig. 6. Apex of leaf, × 285.
Fig. 7. Leaf cells at margin a little above the base, × 285.
Fig. 8. Cross section of costa, × 160.

PLATE 17. *Bryum Dawsonense.*

Fig. 1. Plant, natural size.
Fig. 2. Outer perichaetial leaf, × 12.
Fig. 3. Upper stem leaf, × 12.
Fig. 4. Lower stem leaf, × 12.
Fig. 5. Inner perichaetial leaf, × 12.
Fig. 6. Capsules, moistened, × 8.
Fig. 7. Annulus, × 160.
Fig. 8. Exothecal cells a little above the middle, × 160.
Fig. 9. Stoma, × 160.
Fig. 10. Peristome and part of capsule, × 160.
Fig. 11. Leaf border near middle, × 160.
Fig. 12. Apex of upper leaf, × 160.
Fig. 13. Median leaf-cells, × 160.

PLATE 18. *Bryum conditum.*

Fig. 1. Plant ♂, about natural size.
Fig. 2. Plant ♀, about natural size.
Fig. 3. Outer perichaetial leaf, × 12.
Fig. 4. Upper stem leaf, × 12.
Fig. 5. Capsules showing variations in size, × 8.
Fig. 6. Lower stem leaf, × 12.
Fig. 7. Part of annulus, × 160.
Fig. 8. Median leaf-cells, × 160.
Fig. 9. Inner perichaetial leaf with archegonium, × 12.
Fig. 10. Inner perigonial leaf with antheridium, × 12.
Fig. 11. Part of peristome, × 160.

Fig. 12. Exothecal cells just above the middle, $\times$ 160.
Fig. 13. Apex of perichaetial leaf, $\times$ 80.
Fig. 14. Cross section of upper leaf, $\times$ 160.

PLATE 19. *Bryum submuticum.*

Fig. 1. Plant, natural size.
Fig. 2. Outer perichaetial leaf, $\times$ 20.
Fig. 3. Upper stem leaf, $\times$ 20.
Fig. 4. Inner perichaetial leaf and archegonium, $\times$ 20.
Fig. 5. Capsules, $\times$ 11.
Fig. 6. Part of annulus, $\times$ 160.
Fig. 7. Apex of outer perichaetial leaf, $\times$ 160.
Fig. 8. Inner perigonial leaf with antheridium, $\times$ 20.
Fig. 9. Part of peristome, $\times$ 160.
Fig. 10. Marginal cells of leaf ½ down, $\times$ 160.
Fig. 11. Median leaf-cells, $\times$ 160.
Fig. 12. Perigonium, $\times$ 10.
Fig. 13. Stoma, $\times$ 160.
Fig. 14. Exothecal cells about ½ down, $\times$ 160.

PLATE 20. *Bryum suborbiculare.*

Fig. 1. Plant, natural size.
Fig. 2. Outer perichaetial leaf, $\times$ 20.
Fig. 3. Upper stem leaf, $\times$ 20.
Fig. 4. Lower stem leaf, $\times$ 20.
Fig. 5. Inner perichaetial leaf and archegonium, $\times$ 20.
Fig. 6. Capsules, $\times$ 9.
Fig. 7. Apex of perichaetial leaf, $\times$ 160.
Fig. 8. Part of peristome, $\times$ 160.
Fig. 9. Stoma, $\times$ 160.
Fig. 10. Part of annulus, $\times$ 160.
Fig. 11. Marginal cells ½ down leaf, $\times$ 285.
Fig. 12. Apex of stem leaf, $\times$ 160.
Fig. 13. Exothecal cells ½ down capsule, $\times$ 285.

PLATE 21. *Plagiobryum argenteoides.*

Fig. 1. Terminal stem leaf, $\times$ 50.
Fig. 2. Terminal stem leaf, $\times$ 50.
Fig. 3. Lower stem leaf, $\times$ 50.
Fig. 4. Cross section of stem, $\times$ 205.
Fig. 5. Apex of leaf, $\times$ 205.
Fig. 6. Base of leaf on one side, $\times$ 205.
Fig. 7. Leaf of *P. Zierii* corresponding to number 2, $\times$ 50.
Fig. 8. Basal cells of same corresponding to number 6, $\times$ 205.

PLATE 22. *Polytrichum inconstans* Hagen.

Fig. 1. Leaf, $\times$ 9.
Fig. 2. Cross section of stem, $\times$ 160.

Fig. 3. One half cross section of leaf, × 285.
Fig. 4. Marginal cells ½ down leaf, × 285.
Fig. 5. Upper part of stem, about natural size.
Fig. 6. Apex of leaf, × 80.

PLATE 23. *Brachythecium petrophilum.*

Fig. 1. Plant, about natural size.
Fig. 2. Stem leaf, × 40.
Fig. 3. Branch leaf, × 40.
Fig. 4. Perichaetial leaf, × 40.
Fig. 5. Capsules, × 9.
Fig. 6. Part of peristome, × 160.
Fig. 7. Part of annulus, × 160.
Fig. 8. Alar cells, × 160.
Fig. 9. Apex of leaf, × 285.
Fig. 10. Exothecal cells near middle of capsule, × 160.
Fig. 11. Stoma.
Fig. 12. Section of pedicel near middle, showing papillae, × 285.
Fig. 13. Median leaf-cells, × 285.

PLATE 24. *Harpidium amblyphyllum.*

Fig. 1. Stem leaf, × 12.
Fig. 2. Branch leaf, × 12.
Fig. 3. Capsules, × 10.
Fig. 4. Perichaetial leaf, × 12.
Fig. 5. Apex of stem leaf, × 285.
Fig. 6. Cross section of stem, × 160.
Fig. 7. Part of peristome, × 160.
Fig. 8. Median leaf-cells, × 285.
Fig. 9. Base of leaf on one side, × 285.
Fig. 10. Stoma, × 160.

3. An Enumeration of the Pteridophytes Collected by R. S. Williams and J. B. Tarleton.

BY L. M. UNDERWOOD.

Family OPHIOGLOSSACEAE.

Botrychium Lunaria L. Dawson (Williams).

Family POLYPODIACEAE.

Polypodium vulgare L. Skagway (Williams); 50 miles above Stewart River (Tarleton).

Filix fragilis (L.) Underw. (*Cystopteris fragilis* Bernh.) Dawson and near mouth of the Klondike (Williams); 50 miles above Stewart River (Tarleton).

Filix montana (Lam.) Underw. (*Cystopteris montana* Bernh.) Klondike-Indian Divide (Tarleton).

Dryopteris fragrans (L.) Schott. Dawson; Marsh Lake (Williams); 50 miles above Stewart River (Tarleton).

Phegopteris Dryopteris (L.) Fee; 50 miles above Stewart River (Tarleton).

Phegopteris Robertiana (Hoffm.) A. Br. Dawson, and near mouth of Klondike (Williams).

Family EQUISETACEAE.

Equisetum sylvaticum L. Foot of Lake Lindeman (Williams).

Family LYCOPODIACEAE.

Lycopodium Selago L. Lindeman (Williams); Klondike-Indian Divide (Tarleton).

Lycopodium annotinum L. Lindeman (Williams); 50 miles above Stewart River (Tarleton).

Lycopodium alpinum L. Lindeman (Williams); Klondike-Indian Divide (Tarleton).

Lycopodium clavatum L. Lindeman (Williams).

Family SELAGINELLACEAE.

Selaginella rupestris (L.) Spring. Mountain side, Dawson (Williams; Tarleton).

Selaginella selaginoides (L.) Link. Lindeman (Williams).

4. An Enumeration of the Flowering Plants Collected by R. S. Williams and by J. B. Tarleton.

BY N. L. BRITTON AND P. A. RYDBERG.

The collection of specimens made by Mr. J. B. Tarleton in the valley of the Yukon during the summer of 1899 is the property of the United States National Museum. It supplements that made by Mr. Williams by a considerable number of species and the specimens have in nearly all cases been ample enough to permit a duplicate to be taken for the Garden Herbarium; the types of all the species proposed as new have been so divided.

Family Pinaceae.

Pinus Murrayana Balf. Five-finger Rapids (Williams); twenty miles above Ft. Selkirk (Tarleton).

Juniperus nana Willd. Dawson; Marsh Lake (Williams); Lake Lebarge (Tarleton).

Juniperus prostrata Pers. Near Selkirk (Williams); Lebarge Island (Tarleton).

Tsuga Mertensiana (Bong.) Sargent. Long Lake. Reduced to a low bush (Williams).

Tsuga heterophylla (Raf.) Sargent. Skagway (Williams).

Family Sparganiaceae.

Sparganium minimum Fries. Klondike bottom (Williams).

Family Scheuchzeriaceae.

Triglochin maritima L. Lebarge Island (Tarleton).

Triglochin palustris L. Above Ft. Selkirk (Tarleton).

Family Gramineae.*

Beckmannia erucaeformis (L.) Host. Slough below Rink Rapids (Williams.)

Savastana alpina (Sw.) Scribn. White Pass. (Williams.)

Savastana odorata (L.) Scribn. Thirty-mile River. (Williams); Lebarge Island (Tarleton).

Stipa comata Trin. Five-finger Rapids (Tarleton).

Phleum Haenkeanum Presl.? Dawson, introduced (Williams). Mr. Williams regards this as merely introduced. It has the spike of *P. alpinum* L., but it is a taller and more slender grass, and the awns are much shorter than the empty scales. It differs from *P. pratense* L. in the much larger spikelets and the broader spike, but resembles it in the short awn of the empty scales. It has been provisionally referred as above, although with considerable doubt, as Presl gives a very short description of his species, hardly sufficient to definitely identify it. He states, however, that it is related to *P. alpinum* L., but differs in the shorter awns, and it is on this that I have doubtfully referred it to his species.

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* By George V. Nash.

Alopecurus geniculatus L. Ft. Selkirk (Tarleton).

Alopecurus alpinus J. E. Smith. Ft. Selkirk (Tarleton).

ARCTAGROSTIS ANGUSTIFOLIA Nash, sp. nov.

A rather leafy perennial, with long running rootstocks. Culms erect, rather slender, 10–12 dm. tall, bracted at the base, the bracts gradually passing into leaves: leaves 3 or 4; sheaths, at least all but the lowermost, shorter than the internodes, roughened at the summit; ligule scarious, 5–6 mm. long, decurrent on the sheath; blades apparently lax, rough on both surfaces, 2–3 dm. long, 3–5 mm. wide, long-acuminate: panicle rather slender, contracted, nodding at the apex, 2–2.5 dm. long, its axis smooth, the fasciculate, somewhat hispidulous, branches appressed, the larger ones 4–6 cm. long and naked at the base: spikelets numerous, about 3 mm. long, on hispidulous pedicels usually about 0.5 mm. long; empty scales acute, 1-nerved, or the second sometimes with an additional lateral nerve on each side of the base, the first scale about two-thirds as long as the second which is usually a trifle shorter than the palet; flowering scale acute, about 3 mm. long, strongly hispidulous, usually 1-nerved, or rarely with a very obscure lateral nerve on each side, in side view lanceolate and about 0.5 mm. wide; palet slightly shorter than the scale or equalling it, faintly 2-nerved, strongly hispidulous; stamens 3, about 1.5 mm. long.

Type collected by R. S. Williams on damp mountain side among brush at Dawson, on August 14, 1899; also secured near Big Salmon, on August 22. Resembling *A. poaeoides* described below, and *A. arundinacea* (Trin.) Beal in the basal bracts, from both of which, however, it is clearly distinct in its taller and more slender culms and slender panicle, and the narrow flowering scales, which characters, together with its long lax leaves, at once separate it from *A. poaeoides*.

ARCTAGROSTIS MACROPHYLLA Nash, sp. nov.

A rather leafy perennial, with a running rootstock. Culms rather stout, 4–8 dm. tall, erect; leaves usually 3 or 4; sheaths rather loosely embracing the culm, the lower ones overlapping and exceedingly rough; ligule scarious, 4–5 mm. long, decurrent on the sheath; blades erect, very rough on both surfaces, 2–4 dm. long, 8–12 mm. wide, long-acuminate: panicle contracted, 1.5–2 dm. long, its axis and erect branches rough, the fasciculate branches of varying length,

the larger 6–10 cm. long and naked at the base: spikelets numerous, about 4 mm. long, on hispidulous pedicels 1.5 mm. long or less; empty scales acute, the first scale 1-nerved, about two-thirds as long as the 3-nerved second which is usually about four-fifths as long as the palet; flowering scale about 3.5 mm. long, 5-nerved, the midnerve hispidulous, the two lateral nerves on each side very obscure and sometimes hardly discernible, acute, strongly hispidulous, in side view oblong and about 0.8 mm. wide; palet faintly 2-nerved, strongly hispidulous, from a little shorter than the scale to equalling it; stamens 3, oblong-linear, about 2 mm. long; stigmas 2, plumose.

Type collected by R. S. Williams in wet springy places on mountain sides, Dawson, July 14, 1899. Also collected by F. Funston along the Yukon River, in August, 1893, no. 159, and distributed as *A. arundinacea* Trin. It is quite distinct from that species, being taller and having larger and very rough leaves, and lacking the prominent pointed bracts at the base of the culm which gradually pass into leaves, as indicated by Trinius in his Spec. Gram. Icon. & Descrip. *pl. 55*. There is material in the herbarium of Columbia University from Kotzebue's Sound, the type locality of the *Vilfa arundinacea* Trin., exactly matching this figure.

ARCTAGROSTIS POAEOIDES Nash, sp. nov.

A somewhat tufted perennial, with a branching running rootstock. Culms 6–8 dm. tall, erect, bracted at the base, the bracts gradually passing into leaves: leaves about 4; sheaths striate, shorter than the internodes, very rough; ligule scarious, 4–5 mm. long, decurrent on the sheath; blades erect, stiff, exceedingly rough on both surfaces, long-acuminate, 1.5–2.5 dm. long, 5–6 mm. wide: panicle about 1.5 dm. long, contracted, its axis almost smooth, the fasciculate erect hispidulous branches varying in length, the larger 3–4 cm. long and naked below: spikelets numerous, 2.5–3 mm. long, on somewhat hispidulous pedicels usually less than 1 mm. long; empty scales acute, the first scale 1-nerved, about two-thirds as long as the 3-nerved second which is usually about four-fifths as long as the palet; flowering scale usually a little less than 3 mm. long, strongly hispidulous, 5-nerved, the midnerve hispidulous, the two

lateral nerves on each side very obscure, acute in side view, oblong-lanceolate and about 0.8 mm. wide; palet faintly 2-nerved, strongly hispidulous, usually about equalling the scale; stamens 3, oblong-linear, about 2 mm. long; stigmas 2, plumose.

Type collected by R. S. Williams on mountain side at Dawson, July 14, 1899. Also obtained at Cumberland House, on the Saskatchewan River, in the Lake Winnipeg region, and communicated to Torrey by Hooker, and bearing the number 105. Resembling *A. arundinacea* (Trin.) Beal in the bracts at the base, but it is a taller and much rougher plant with a more contracted panicle and smaller spikelets.

Agrostis hyemalis (Walt.) B.S.P. Dawson, August 13 and 23, 1899 (Williams), referred for the present to this complex species.

CALAMAGROSTIS ATROPURPUREA Nash, sp. nov.

A tall perennial with a rather stout long rootstock and deep purple contracted panicle. Culms 8–12 dm. tall, erect, smooth, or a little roughened just below the panicle: leaves about 5; sheaths striate, somewhat roughened, especially toward the apex, rather loosely embracing the culm; ligule scarious, about 5 mm. long; blades erect, flat, strongly roughened, long-acuminate, 1–2 dm. long, 3–5 mm. wide: panicle contracted, about 1 dm. long, its branches and their divisions extremely hispidulous, erect, the larger ones 2–4 cm. long, not spikelet-bearing below: spikelets numerous, 3.5 mm. long, lanceolate, acute; empty scales strongly strigose, deep purple, acuminate, rounded on the back, the first scale 1-nerved, equalling or slightly longer than the 3-nerved second; flowering scale about 2.8 mm. long, usually deep purple at the base, 5-nerved, the nerves converging above and indistinctly excurrent, the strongly hispidulous rather stout awn inserted about the middle and extending to or considerably beyond the apex of the scale; callus-hairs rather copious, in two lateral tufts, generally a little exceeding the scale; rudiment about 0.5 mm. long, its hairs extending to the apex of the scale; palet about two-thirds as long as the scale.

On wooded hillsides, Dawson, July 14, 1899 (R. S. Williams). Related to *C. Scribneri* Beal, but the much

longer callus-hairs and the deep purple color of the panicle readily distinguish it.

Calamagrostis Canadensis acuminata Vasey. Dawson, July 14, 1899; Klondike City, July 23, 1899; Bennett City, August 25, 1899 (Williams).

Calamagrostis Lapponica (Wahl.) Hartm. Dawson, July 13, 1899 (Williams). This exactly matches a specimen in the herbarium of Columbia University from Wahlenberg, labeled *Arundo Lapponica*. It has long been uncertain whether we had this species in this country, but this collection definitely settles the point, if the specimen from Wahlenberg, above referred to, is typical of his species, the original description, however, calling for a taller plant. The grass secured by Mr. Williams is a tufted perennial with culms erect and 3–4 dm. tall, the innovations being about one-third as long as the culm with their leaf-blades very narrow and often involute: panicle contracted, 7–9 cm. long and 1 cm. or a little more wide, its branches erect: spikelets about 5 mm. long, purple toward the apex, the flowering scale a little exceeding the copious basal hairs and with a rather stout awn inserted at or near the middle and about reaching the apex of the scale.

Calamagrostis Yukonensis Nash, sp. nov.

A tall slender perennial with a slender running rootstock, narrow leaf-blades, and marcescent basal sheaths. Culms 8–10 dm. tall, erect, the innovations nearly one-half as long as the culms: culm-leaves 2; sheaths very rough, much shorter than the internodes; ligule scarious, about 5 mm. long, decurrent on the sheath; blades gray-green, erect or ascending, long-acuminate, very rough on the lower surface, the upper surface strongly pubescent with short hairs, the longer blades on the innovations about 3 dm. long and 2 mm. wide, those on the culm 1–2 dm. long and 3–4 mm. wide: panicle 8–15 cm. long, contracted, its apex sometimes nodding, the branches erect, fascicled, strongly hispidulous, the longer ones 3–4 cm. long, naked at the base: spikelets numerous, on strongly hispid pedicels usually 1–2 mm. long; empty scales hispidulous, strongly so on the prominent keel, very acute, yellowish, variegated with purple, the first scale 5–6 mm. long, 1-nerved, or sometimes with a short lateral

nerve on each side near the base, broader than and a little exceeding the 3-nerved second; flowering scale strongly hispidulous, 4–5 mm. long, 5-nerved, the nerves usually excurrent in short awns, the dorsal awn inserted about one-quarter way from the base of the scale, its column yellowish brown, closely spiral and about reaching the apex of the scale where it is strongly bent, the divergent portion much exserted and 5–6 mm. long; palet a little shorter than the scale, irregularly and finely toothed at the apex, 2-nerved, the nerves sometimes barely excurrent; callus with a tuft of hairs on each side about 0.5 mm. long, the dorsal portion naked: rudiment $\frac{1}{3}$ to $\frac{1}{2}$ as long as the scale, pubescent with erect hairs 1 mm. or a little less long, sometimes bearing an awn.

Type collected by R. S. Williams in dry soil in open places at Dawson. There is also a specimen in the herbarium of Columbia University collected by Kennicott on the Yukon River, but with no other data. Related to *C. Tweedyi* Scribn., but its more slender culms and narrower more open panicle, long and narrow leaf-blades with the upper surface pubescent, and the smaller spikelets readily separate it.

Calamagrostis purpurascens R. Br.? An unusual loose-panicled form with large anthers, fully 3 mm. long. It may be undescribed. Five-finger Rapids (Tarleton).

Deschampsia atropurpurea (Wahl.) Scheele. White Pass, August 26, 1899 (Williams). The branches of the panicle are exceedingly long, much longer than in the typical form, the lower ones being 10–12 cm. long, spikelet-bearing only at the summit, and drooping. The spikelets, however, are identical with those of the common form.

Deschampsia caespitosa (L.) Beauv. Dawson (Williams).

Deschampsia calycina Presl. Dawson (Williams). Regarded by the collector as introduced.

Trisetum Alaskanum Nash, sp. nov.

A tufted pubescent perennial with the innovations about one-half as long as the culms. Culms 2–4 dm. tall, stout, ascending, densely villous with reflexed hairs: leaves 2; sheaths loose, pubescent with soft reflexed hairs; ligule scarious, about 1 mm. long; blades lax, pubescent with soft spreading hairs, those on the culm 8–10 cm. long, 3–4 mm.

wide, those on the innovations narrower and longer: panicle contracted, strict, 4–5 cm. long, 1–1.5 cm. thick, its axis and appressed branches pubescent with long hairs, the branches spikelet-bearing to the base, the larger ones 1–1.5 cm. long: spikelets 6–7 mm. long, crowded, 2–3-flowered; empty scales brownish or yellowish brown, strongly hispidulous on the keel, sparingly so on the surface, the midnerve excurrent in a short point, the first scale 1-nerved, the second 3-nerved; flowering scales strongly hispidulous, not exserted, the callus pubescent with hairs about 0.25 mm. long, acute, shortly 2-toothed at the apex, the teeth awn-pointed, the awn inserted about one-third way down, stout, hispidulous, finally strongly reflexed, about the length of the scale; palet about four-fifths as long as the scale, 2-toothed at the apex.

On steep open hillsides, Skagway, August 28, 1899 (Williams). Related to *T. subspicatum* (L.) Beauv., but the larger spikelets with their included flowering scales at once distinguish it from any form of that species.

Trisetum subspicatum (L.) Beauv. Dawson (Williams).

Trisetum subspicatum molle (Michx.) A. Gray. Summit of White Pass (Williams); Ft. Selkirk (Tarleton).

Trisetum sp. Five-finger Rapids, Aug. 21, 1899 (Williams). This is probably undescribed, but the parts of the spikelets are so abnormally large, owing to its infestation by nematode worms, that its description as new is not warranted.

Avena sativa L. Dawson. Introduced (Williams).

Poa arctica R. Br. Klondike Bottom (Williams).

Poa nemoralis L. Dawson (Williams).

Poa nemoralis L. ? Dawson (Williams).

Poa nemoralis L.? Five-finger Rapids (Tarleton).

Poa pratensis L. Rink Rapids (Williams).

POA WILLIAMSII Nash, sp. nov.

A tufted smooth and glabrous perennial, the innovations apparently intravaginal and much shorter than the culm. Culms 1.5–2 dm. tall, erect or ascending: leaves 1 or 2; sheaths striate; ligule scarious, about 2.5 mm. long; blades erect, about 2 mm. wide, acuminate, those on the culm 2–4 cm. long, those on the innovations sometimes longer: panicle

4–6 cm. long, its branches ascending, the larger ones 2–2.5 cm. long, spikelet-bearing above the middle: spikelets longer than their pedicels, in 2's–4's on the larger branches, variegated with yellowish brown and purple, 3–4-flowered, 5–6 mm. long; empty scales acuminate, hispidulous on the keel above the middle, the first scale 1-nerved, the second 3-nerved at the base, the lateral nerves vanishing below the apex, the first scale about three fourths as long as the second which is a little shorter than its adjacent flowering scale; flowering scale acute, hispidulous on the midnerve above the middle, cobwebby at the base, the lower ones about 4.5 mm. long, 5-nerved, the midnerve and lateral nerves prominent, densely pubescent below the middle with silky hairs, the intermediate nerves rather faint, sometimes sparingly pubescent, the internerves hispidulous at the apex and minutely pubescent toward the base; palet a little shorter than the scale, 2-keeled, the keels hispidulous.

Along a brook, summit of White Pass, R. S. Williams, Aug. 26, 1899. Related to *P. arctica* R. Br., but distinguished by its innovations and the narrower acute flowering scales.

Colpodium pendulinum (Vahl) Griseb. Mouth of Klondike (Williams).

Panicularia pulchella Nash sp. nov.

A leafy glabrous perennial, apparently with a running rootstock. Culms 4–5 dm. tall, stout, smooth: leaves crowded; sheaths overlapping and loose, rough; ligule scarious, 2–2.5 mm. long; blades erect, rough, long-acuminate, 1.5–2 dm. long, 2.5–5 mm. wide: panicle loose and open, 1.5–2.5 dm. long, its smooth more or less flexuous slender dividing branches ascending or nearly erect, the larger ones 8–11 cm. long, naked toward the base: spikelets longer than their pedicels, 5–6 mm. long, 4–6-flowered; empty scales brownish, scarious margined, irregularly toothed at the rounded or obtuse apex, much shorter than their adjacent flowering scales, the first scale 1-nerved, shorter than the second which is 3-nerved at the base; flowering scales usually purple, with a broad hyaline margin above the middle, strongly but minutely hispidulous, oval when spread out, prominently 7-nerved, obscurely and irregularly toothed at the rounded apex, the lower ones about 3 mm. long; palet slightly shorter than the scale.

Type collected by R. S. Williams in low marshy ground in river bottoms near White River, Aug. 17, 1899. Also secured by Messrs. Onion, Kennicott and Hardisty in 1861–62. It has somewhat the appearance of low forms of *P. pauciflora* (Presl) Kuntze, but it is stouter and more leafy, and the flowering scales are longer and not truncate at the apex as in that species. The deep purple of the flowering scales makes a strong contrast with their broad white hyaline margins, giving the spikelets a beautiful and striking appearance.

Festuca Altaica Trin. Hillsides at Dawson, June 25 and July 13, 1899; White Pass, August 26, 1899 (Williams). This is closely related to *F. scabrella* Torr., differing in its more acuminate flowering scales, but otherwise strongly resembling it. Should it prove the same, Torrey's name must be considered a synonym, it having been published several years later than that of Trinius.

Festuca ovina polyphylla Vasey. Skagway (Williams).

Bromus Pumpellianus Scribn. Dawson (Williams); Ft. Selkirk (Tarleton).

Bromus racemosus L. Dawson. Introduced (Williams).

Agropyron Richardsoni Schrad. Dawson (Williams).

Agropyron spicatum tenuispicum (S. & S.) Rydberg. Dawson (Williams).

Agropyron tenerum Vasey. River bank opposite Dawson (Williams).

Hordeum nodosum L. Dawson. Introduced (Williams).

Elymus arenarius L. Skagway (Williams).

Family CYPERACEAE.

Eriophorum polystachyon L. Mouth of Klondike (Williams).

Eriophorum vaginatum L. Dawson; below White Horse Rapids; Klondike River Bottom (Williams); Five-finger Rapids (Tarleton).

Carex vesicaria L. Dawson; Klondike River Bottom (Williams).

Carex saxatilis L. Thirty-mile River (Williams).

Carex Grahami Boott. Near Stewart River (Williams).

Carex alpina Sw. Dawson (Williams); White Horse Rapids (Tarleton).

Carex Gmelini Hook. Skagway (Williams).

Carex stylosa Drejer. Mouth of Bonanza; also a specimen doubtfully referred to this species from Dawson Swamp (Williams).

Carex Yukonensis Britton sp. nov.

Group of *C. caespitosa*. Culms slender, roughish, 2.5–4 dm. high, longer than the leaves. Leaves narrowly linear, roughish margined, 2 mm. wide, the midvein prominent: lowest spike subtended by a nearly filiform bract 1–2.5 cm. long; staminate spike terminal, stalked, 2–2.5 cm. long; pistillate spikes 2 or 3, 1.5–2 cm. long, 2.5 mm. thick, dense, apparently erect, the upper nearly sessile, the lower one, when 3 are present, filiform-stalked, loosely flowered toward the base; perigynia nearly orbicular, nerveless, 1 mm. in diameter, very minutely beaked, lenticular, sharply margined, about as long as the black, ovate-oblong, acute or acutish scale; stigmas 2 or 3.

Mouth of Bonanza Creek, R. S. Willliams, June 18, 1899.

Carex rigida Good?. Mouth of Bonanza Creek (Williams).

Carex acuina Bailey. Mouth of Klondike (Williams).

Carex podocarpa R. Br. White Pass (Williams).

Carex Magellanica Lam. Klondike River Bottom; near Mouth of Klondike (Williams).

Carex capillaris L. Dawson (Williams).

Carex altocaulis (Dewey) Britton. Hillside among willows, Dawson and at Walker Gulch (Williams).

Carex bicolor All. Ten miles above Lebarge (Williams).

Carex concinna R. Br. Dawson (Williams); Lake Bennett (Tarleton).

Carex filifolia Nutt. Miles Cañon (Williams).

Carex Williamsii Britton, sp. nov.

Glabrous; culms filiform, smooth, 1–2.5 dm. high. Leaves filiform-linear, shorter than the culms, equitant, 1 mm. wide

or less, the margins minutely serrulate at least below; spikes 3 or 4, 3–6-flowered, the uppermost staminate above with 1 or 2 pistillate flowers below, the others pistillate, the lower 1 or 2 on filiform erect stalks 1.5 cm. long or less, subtended by leaf-like bracts which sometimes exceed them; scales oval, brown, acute, or obtusish, distant on the filiform rachis, nearly 2 mm. long; perigynia spindle-shaped, few-nerved, 3–3.5 mm. long, less than 1 mm. wide, readily deciduous, the orifice entire; stigmas 3.

Dawson, R. S. Williams, June 12, 1899 (type); also, by the same collector, near the same locality August 1, 1899.

Carex teretiuscula Good. Klondike River Bottom; near mouth of Klondike (Williams).

Carex tenella Schk. Klondike River Bottom (Williams).

Carex capitata L. Ten miles above Lebarge; Dawson Swamp (Williams).

Carex Redowskyana C. A. Meyer. Bennett City (Williams).

Carex Bonanzensis Britton, sp. nov.

Group of *C. canescens*. Glabrous; culms about 4 dm. high, roughish above. Leaves nearly equalling the culm, very rough-margined, 2 mm. wide. Spikes about 7, sessile, the upper clustered, the lower somewhat separated, oblong, obtuse, about 8 mm. long, and 3 mm. thick, the lowest subtended by a filiform flattened serrulate bract 2–2.5 cm. long; scales ovate, with broad brown margins, shorter than the perigynia, the lower acute, the upper obtuse; perigynia nearly white, plano-convex, glabrous, rather strongly several-nerved on both faces, 1.5 mm. long, 1 mm. wide, minutely beaked.

Mouth of Bonanza Creek, R. S. Williams, June 18, 1899.

Carex tenuiflora Wahl. Dawson (Williams).

Carex lagopina Wahl. White Pass (Williams).

Carex praticola Rydb. Walker Gulch (Williams).

Family Juncaceae.

Juncus Balticus L. Near Stewart River (Williams).

Juncus Richardsonianus Schultes. Near Indian River (Tarleton).

Juncus Mertensianus Bong. Bennett City (Williams).

Juncoides pilosum (L.) Kuntze. Dawson; Klondike City (Williams).

Juncoides glabratum (Hoppe) Sheldon. Bennett City (Williams).

Juncoides arcuatum (L.) Kuntze? White Pass (Williams).

Family MELANTHACEAE.

Tofieldia palustris Huds. Bennett City (Williams); Lake Lebarge and below Stewart River (Tarleton).

Zygadenus elegans Pursh. Dawson (Williams); Five-finger Rapids (Tarleton).

Family LILIACEAE.

Allium Sibiricum L. Rink Rapids (Williams); above Ft. Selkirk (Tarleton).

Family CONVALLARIACEAE.

Vagnera stellata (L.) Morong. Above Ft. Selkirk (Tarleton).

Family ORCHIDACEAE.

Cypripedium guttatum Sw. Dawson (Williams); near Sixty-mile Creek (Tarleton).

Cypripedium passerinum Richards. Mountain side near Dawson (Williams); Lake Lebarge (Tarleton).

Lysiella obtusata (Pursh) Rydb. Near mouth of Klondike; Dawson (Williams); Lake Lebarge and above Ft. Selkirk (Tarleton).

Limnorchis brachypetala Rydb. sp. nov.

Roots fascicled, fleshy, the largest 7–8 mm. in diameter; stem 1.5–2.5 dm. high, slender, striate, glabrous, 4–5-leaved. Lower leaves oblong, obtuse, 4–6 cm. long, half-clasping, strongly nerved; upper leaves lanceolate, acute; bracts linear-lanceolate, the lower 2–3 times as long as the flowers, the upper much shorter; flowers greenish or brownish, about 8 mm. long; upper sepal about 2 mm. long, nearly orbicular, slightly truncate and indistinctly 3-toothed at the apex, 3-nerved, somewhat arched; lateral sepals oval-oblong, obtuse, spreading, nearly 3 mm. long; upper petals round-ovate, acute, slightly over 1 mm. long, very narrow, a little dilated

at the base and near the apex, acute; spur club-shaped or almost saccate, nearly straight, about equalling the lip in length; ovary 8–9 mm. long in fruit, oblong-ellipsoid.

Apparently nearest related to *L. hyperborea*, but smaller in every way; the spur is not curved forward as in that species, and the petals are very broad and short, scarcely more than half as long as the upper sepal; the spur resembles that of *L. stricta*, but that species has much larger flowers, comparatively longer linear lip, longer petals and reflexed lower sepals. Type collected by R. S. Williams at Bennett City, August 25, 1899; also collected by Tarleton above Ft. Selkirk.

Limnorchis leptoceratitis Rydb. sp. nov.

Roots fascicled, fleshy, fibrous; stem slender, striate, glabrous, 2–4 dm. high. Lower leaves oblong, obtuse, half-clasping, 4–8 cm. long; upper leaves linear-lanceolate, acute; bracts linear-lanceolate, the lower somewhat longer than the white flowers, the upper shorter; sepals 3–4 mm. long, broadly lanceolate, the upper erect and almost straight, the lateral ones reflexed-spreading, 3-nerved, acute; upper petals linear, acute, about as long as the sepals; lip lanceolate, obtuse, somewhat rhombic-dilated at the base, equalling the sepals; spur very slender, cylindric, curved forward, a little exceeding the lip; ovary 8–9 mm. long in fruit, ellipsoid.

Nearest related to *L. dilatata* (*Habenaria dilatata*), from which it differs in the longer spur, which is not at all clavate, the narrower petals, smaller flowers, and shorter, more obtuse leaves. Type collected by R. S. Williams at Bennett City, Aug. 25, 1899. Also collected by J. Albert Rudkin in southern Alaska, 1883, and by J. M. Macoun in Unalaska, July 25, 1891.

Orchis rotundifolia Pursh. Lake Lebarge (Tarleton).

Peramium repens (L.) Salisb. Below Selkirk (Williams).

Corallorhiza Corallorhiza (L.) Karst. Thirty-mile River (Williams); fruiting specimen only, and determination doubtful. White Horse Rapids and above Fort Selkirk (Tarleton).

Gyrostachys Romanzoffiana (Cham.) MacM. Swamp, Dawson (Williams).

Gyrostachys stricta Rydb. Klondike Bottom (Williams); Sixty-mile Creek (Tarleton).

Listera borealis Morong. Five-finger Rapids (Tarleton).

Sub-class DICOTYLEDONES.

Family Salicaceae.

Populus tremuloides Michx. Dawson (Williams).

Populus balsamifera L. River bank opposite Dawson (Williams).

Salix myrtillifolia Anders. Below White Horse Rapids; Dawson Swamp (Williams); Lake Bennett (Tarleton).

Salix perrostrata Rydb., sp. nov.

A shrub, 1–4 m. high with grayish, rough and scaly bark; branches yellow or the youngest tinged with red, at first finely pubescent; leaves obovate-lanceolate or oblanceolate, when young finely silky, in age glabrate, 2–4 cm. long, 1–1.5 cm. wide, acute at both ends, and with undulate margins, light green above and paler beneath; petioles 2–6 mm.; stipules minute, deciduous; aments somewhat leafy bracted, almost sessile; the staminate 1–1.5 cm. long, the pistillate in fruit 2–3 cm.; capsule conic, long-rostrate; stigma subsessile.

Black Hills of S. Dakota and Pine Ridge, Neb., to Colorado and Alaska, May–June. (*S. Bebbiana* Rydb. Cont. U. S. Nat. Herb. **3**: 523, mainly, not Sarg.)

Type collected near Hermosa, Black Hills of South Dakota, 1892, P. A. Rydberg, 1018. Hillsides, Dawson, R. S. Williams.

Salix anglorum Cham. Summit of White Pass (Williams).

Salix orbicularis Anders. Summit of White Pass (Williams); Lake Bennett (Tarleton).

Salix phlebophylla Anders. Summit of White Pass.

Salix chlorophylla Anders. ? Dawson Swamp (Williams).

Salix longistylis Rydb. sp. nov.

A shrub, 4–5 m. high, with stems 13–15 cm. thick, the bark of the branches greenish brown or purplish, pubescent

when young. Leaves obovate, thick, acutish, minutely glandular-denticulate, the upper surface slightly villous when young, soon glabrate and shining, the lower surface densely white-tomentose; pistillate aments almost naked, from lateral buds, 4–5 cm. long, 1 cm. thick; bracts obovate, obtuse, about 3 mm. long, almost black, subsessile; ovary about 5 mm. long, densely villous; style slender, over 2 mm. long, the divisions fully 1 mm. long.

Perhaps nearest related to *S. Sitchensis*, but readily distinguished from that species by the much larger ovary, the long and slender style and stigmas and the broader and darker bracts. Mouth of the Klondike, May 30, 1899 (Williams).

Salix Alaxensis (Anders.) Coville. Lake Bennett (Tarleton). Determined by Mr. F. V. Coville.

Salix Saskatchewana Seem.? Dawson (Williams).

Salix Richardsoni Hook. Lake Bennett (Tarleton). Determined by Mr. F. V. Coville.

Salix Seemannii Rydb. sp. nov.

A shrub, 3–4 m. high, the bark of the older branches dark brown, that of the younger ones lighter, those of the season villous-pubescent. Leaves oval to oblong-lanceolate, acute at both ends, 3–7 cm. long, rather firm, entire; upper surface silky-villous when young, glabrate and bright green in age; lower surface permanently densely white or grayish silky-villous; aments on short lateral branches which bear 3–5 small leaves, the pistillate ones 4–7 cm. long, rather loose; bracts oblong, obtuse, light brown, somewhat villous, about 2 mm. long; ovary in anthesis 3–4 mm. long, in fruit about 8 mm. long, densely white-villous, subsessile; style 0.5–1 mm. long; stigmas slender, about 1 mm. long, 2-cleft at the apex; staminate aments 2–3 cm. long; stamens 2; filaments slender, about 8 mm. long, free.

Seemann's specimens, cited below, were named by Hooker *Salix glauca* var. *macrocarpa*, but the plant is neither *S. macrocarpa* of Trautvetter, nor that of Nuttall; it is related to the former, but not to the latter. *S. macrocarpa* Trautv. (*S. glauca macrocarpa* Ledeb.) is described as having sessile

stigmas and fuscous bracts; it probably does not occur in America.

Type collected at Dawson by R. S. Williams, June 11, 1899, a more mature specimen June 12. Also collected by Seemann on Chamisso Island, 1851, no. 1783, and Kotzebue Sound and Norton Sound, 1849, no. 1423.

Family BETULACEAE.

Betula glandulosa Michx. Dawson (Williams); Ft. Selkirk (Tarleton).

Betula papyrifera Marsh. Skagway.

Betula resinifera (Regel) Britton.

B. alba subsp. *verrucosa* var. *resinifera* Regel, Bull. Soc. Mosc. **18**: 398. 1865.

A white barked tree, sometimes 15 m. high, the trunk reaching 3 dm. in diameter, the young twigs densely glandular-resiniferous. Leaves deltoid-ovate, acuminate, sharply irregularly serrate, broadly cuneate, truncate, or some of them cordate at the base, dark green above, pale, and when young resinous-glandular beneath, glabrous, slender-petioled; blades 5–8 cm. long, 4–7 cm. wide just above the base; petioles 1.5–2.5 cm. long; young staminate aments 2 or 3 together; ripe pistillate aments slender-peduncled, cylindric, 3 cm. long, 1–1.2 cm. thick; pistillate scales about equally 3-lobed, the middle lobe lanceolate, acute, the lateral ones obliquely oblong-obovate, obtuse, all 3 ciliate; wings of the seed rather broader than its body.

Dawson, R. S. Williams, Aug. 13, 1899 (type); Ft. Selkirk, J. B. Tarleton, no. 138, July 18, 1899. Specimens in the National Herbarium, obtained by Miss E. Taylor on Peel's River, July 14, 1892, and at Ft. Simpson in 1860, no collector indicated, are also referable to this species.

Our material agrees in every respect with Regel's description in De Candolle's Prodromus, **16**: Part 2, 164. 1868.

The tree is evidently more closely related to the Old World *Betula alba* than to either of the other American white-barked species *B. papyrifera* and *B. populifolia*, and is an interesting addition to our arboreous flora.

Alnus tenuifolia Nutt. River bank opposite Dawson (Williams).

Alnus fruticosa Rupr. Dawson (Williams); Ft. Selkirk (Tarleton). Agrees with Asiatic specimens so determined, and seems distinct from *Alnus Alno-Betula*.

Family Urticaceae.

Urtica gracilis Ait. Dawson (Williams).

Family Chenopodiaceae.

Blitum capitatum L. Dawson (Williams); near Sixtymile Creek (Tarleton).

Family Polygonaceae.

Polygonum amphibium L. Ft. Selkirk (Tarleton).

Polygonum viviparum L. Bennett City (Williams); above Ft. Selkirk (Tarleton).

Polygonum alpinum Alaskanum Small. Klondike below Bonanza (Williams); above Stewart River (Tarleton).

Polygonum plumosum Small sp. nov.

Perennial, deep green. Stems erect, 1–3 dm. tall, simple, glabrous: leaves few; blades thickish, sparingly pubescent beneath, those of the basal and lower stem-leaves ovate to oblong-ovate or broadly oblong, 2–5 cm. long, blunt or markedly obtuse, abruptly narrowed or subcordate at the base, as long as their petioles or shorter, those of the upper stem-leaves mostly oblong, short-petioled or nearly sessile, all more or less revolute and with prominent nerves about the edge: ocreae ample, prolonged into a narrowly funnelform sheath, persistent: racemes cylindric, 2–6 cm. long, dense: flowers persistent: calices rose-colored; lobes usually 5, broadly oblong or oval, 3.5–5 mm. long, obtuse or nearly truncate at the apex, often inequilateral: stamens exserted; filaments slightly flattened; anthers dark brown or blackish: styles 3, elongated; stigmas capitate, minute: achenes 3-angled, ovoid or oval, 3–3.5 mm. long.

Related to *Polygonum bistortoides* Pursh; but it is stouter and more stocky in habit. It differs from *P. bistortoides* very conspicuously in its leathery and pubescent leaf-blades,

in the deep rose-colored calices and the narrow cylindric raceme, and the pedicels are only about one-half as long as those of its relative. The species has been collected several times during the past decade; all the specimens having been found in Alaska or on the neighboring islands.

St. Paul's Island. Bering Sea Commission Collection, no. 130. July 29, 1891. J. M. Macoun, collector. (Type.)

Porcupine River, Alaska, 1891. J. Henry Turner, collector.

Port Clarence, Alaska. Harriman Alaska Expedition, no. 1970. July 12, 1899. F. V. Coville and T. H. Kearney, Jr., collectors.

Hall Island, Bering Sea. Harriman Alaska Expedition, no. 2023. July 14, 1899. F. V. Coville and T. H. Kearney, Jr., collectors.

Klondike, "The Dome." August 10, 1899. J. B. Tarleton, no. 175b.

Polygonum fugax Small sp. nov.

Perennial from horizontal rootstocks, bright green. Stems erect, 3–4 dm. tall, glabrous, discolored below the nodes and the inflorescence: basal leaves several; blades lanceolate or oblong-lanceolate, 5–12 cm. long, acute, undulate, finely wrinkled above, minutely pubescent beneath, slightly revolute, cuneately narrowed at the base; petioles as long as the blades or longer, winged near the top: stem-leaves nearly similar to the basal, but with smaller and narrower blades and short petioles: ocreae delicate, closely surrounding the internodes of the stem, except the loose and obliquely open top: spike cylindric or nearly so, 2.5–5 cm. long, about 1 cm. thick, erect: bracts very delicate, light brown, ovate-lanceolate to oval, acuminate, 5–7 mm. long: flowers early deciduous or fugacious: calyxes pink; lobes various, the inner oblong, obtuse, the outer larger and all three of different sizes: stamens 8: achenes 3-angled, oval, dark brown, abruptly acute.

Related to *Polygonum Bistorta* L., but more slender and with much more delicate parts throughout. The leaves differ from those of *P. Bistorta* in having lanceolate or oblong-lanceolate blades with narrowed bases. The inflorescence

differs in being spicate instead of racemose, while the individual flowers, instead of persisting, fall away easily and early, perhaps before the fruit is fully matured.

The only specimens known were found growing in moss below Sixty mile Creek, by J. B. Tarleton, August 3, 1899, no. 175a.

Family SANTALACEAE.

Comandra livida Richards. Dawson (Williams); Lake Bennett (Tarleton).

Family CARYOPHYLLACEAE.

Silene repens Patrin. Dawson; Walker Gulch (Williams); Ft. Selkirk (Tarleton).

Silene Williamsii Britton sp. nov.

Related to *S. Menziesii* Hook. Viscid-pubescent all over; stem 1–3 dm. high, the slender branches widely ascending. Leaves lanceolate to ovate-lanceolate, sessile, firm, entire, 2–3 cm. long, 5–10 mm. wide, acuminate at the apex, narrowed at the base; cymes terminal, few-flowered; pedicels filiform, 5–10 mm. long; calyx urceolate, its teeth about 2 mm. long, erect, the whole about 8 mm. long; petals scarcely longer than the calyx.

Dawson, R. S. Williams, July 14, 1899 (type); fifty miles above Stewart River (Tarleton).

Lychnis triflora R. Br. Stream by West Dawson (Williams).

Vaccaria Vaccaria (L.) Britton. Dawson, introduced (Williams).

Cerastium arvense L. Lebarge Island (Tarleton).

Cerastium vulgatum L. Dawson, introduced (Williams).

Cerastium maximum L. Above Stewart River (Tarleton).

Alsine borealis (Bigel.) Britton. Dawson (Williams); Five-finger Rapids (Tarleton).

Alsine laeta (Richards.) Rydb. Dawson (Williams); White Horse Rapids (Tarleton).

Alsine crassifolia (Ehrh.) Britton. Five-finger Rapids (Tarleton).

Moehringia lateriflora (L.) Fenzl. Dawson (Williams); Five-finger Rapids (Tarleton).

Merckia physodes Fisch. Mouth of Klondike (Williams); above Stewart River (Tarleton).

Arenaria laricifolia L. Dawson (Williams).

Arenaria triflora (L.) S. Wats. Lebarge Island (Tarleton).

Arenaria Dawsonensis Britton, sp. nov.

Glabrous. Stems very slender, several times forked, 1.5–3 dm. high. Leaves narrowly linear, smooth, blunt-pointed, the lower 1–1.5 cm. long, 0.5–1.3 mm. wide, firm, the lowest sometimes with fascicles of smaller ones in their axils, the uppermost reduced to bracts; lower internodes 4–6 cm. long; pedicels filiform, divergent-ascending, straight; sepals oblong-lanceolate, acute, strongly 3-nerved, 4 mm. long, 1–1.5 mm. wide, the calyx impressed at the base; petals oblong, a little shorter than the sepals or equalling them; pod narrowly ovoid, membranous, 3-valved, a little longer than the sepals: seeds oval-oblong, reddish brown, 0.6–0.7 mm. long, roughened with low irregular ridges.

Dawson, R. S. Williams, July 16, 1899.

Apparently nearest to *A. Michauxii* (Fenzl.) Hook., but with short petals, merely acute sepals and much longer internodes.

Family RANUNCULACEAE.

Actaea arguta Nutt. Five-finger Rapids (Tarleton).

Anemone Richardsoni Hook. Near mouth of Bonanza (Williams); near Selwyn River (Tarleton).

Anemone parviflora Michx. Dawson (Williams); White Horse Rapids and Lake Bennett (Tarleton).

Anemone globosa Nutt. Lake Lebarge and White Horse Rapids (Tarleton).

Pulsatilla hirsutissima (Pursh) Britton. Near Hootalinqua (Williams); Lake Bennett and Lake Lebarge (Tarleton).

Ranunculus Yukonensis Britton, sp. nov.

Group of *R. Purshii.* Stems almost filiform, 1 dm. long or less, sparingly pubescent toward the end. Leaves slender-petioled, 6–14 mm. wide, dissected into linear, entire or

toothed, obtuse segments; flowers several, slender-peduncled, 6–10 mm. broad; sepals broadly ovate, obtuse; head of fruit globular, 2–3 mm. in diameter; achenes slightly compressed, about 1 mm. long, abruptly tipped with a hooked beak of one third their length.

Mouth of the Bonanza, June 18, 1899, R. S. Williams (type); mouth of the Klondike, July 9, 1899, same collector.

Ranunculus Purshii Richards. Island below Stewart River (Tarleton).

Ranunculus Lapponicus L. Klondike River (Tarleton); near mouth of Bonanza (Williams).

Delphinium glaucum S. Wats. Dawson (Williams); above Fort Selkirk and below Stewart River (Tarleton).

Aconitum delphinifolium DC. Dawson (Williams); Fort Selkirk (Tarleton).

Aconitum paradoxum Reichenb.? Summit of White Pass (Williams). This is an interesting plant with short obtuse leaf-lobes, and larger flowers than *A. delphinifolium.* It appears to be the same as specimens collected on the Harriman Expedition to Alaska by Messrs. Coville and Kearney at Plover Bay and Port Clarence, Siberia. Mr. Williams' specimens are referred to Reichenbach's species with much doubt.

Aquilegia brevistyla Hook. Dawson (Williams); Five-finger Rapids (Tarleton).

Thalictrum sparsiflorum Turcz. Mouth of the Klondike (Williams); Five-finger Rapids (Tarleton).

Family Papaveraceae.

Papaver nudicaule L. Below Selwyn River (Tarleton).

Family Fumariaceae.

Capnoides aureum (Willd.) Kuntze. Lake Lebarge and Bonanza Creek (Tarleton); Dawson and Walker Gulch (Williams).

Capnoides sempervirens (L.) Borckh. Dawson (Williams); Bonanza Creek (Tarleton).

Family Cruciferae.

Cardamine pratensis angustifolia Hook. Near mouth of Bonanza and mouth of Klondike (Williams).

Roripa Williamsii Britton, sp. nov.

Glabrous, about 1.5 dm. high. Leaves about 5 cm. long, deeply pinnatifid into oblong, obtuse, entire or toothed segments 2–3 mm. wide, the terminal segment much larger than the lateral ones; racemes elongating and with very distant pedicels in fruit; pedicels spreading, about 1 cm. long; pod oblong, obtuse, about 3 mm. long.

Near mouth of Bonanza Creek, R. S. Williams, June 18, 1899.

Arabis lyrata occidentalis S. Wats. Near mouth of Bonanza (Williams).

Arabis Holboellii Hornem. White Horse Rapids (Tarleton).

Parrya macrocarpa R. Br. The Dome, Klondike-Indian Divide (Tarleton).

Erysimum cheiranthoides L. Dawson (Williams).

Erysimum angustatum Rydb., sp. nov.

A more or less cespitose perennial, with a slender tap-root and short branched rootstock or caudex. Stems 1–2 dm. high, sparingly grayish strigose, obtusely angled; leaves very narrowly oblanceolate-linear or linear, 4–7 cm. long, 1–2 mm. wide, grayish strigose; sepals linear, obtuse, about 8 mm. long, two alternate ones deeply saccate at the base, pale yellowish; petals lemon-yellow, about 14 mm. long; pods 5–8 cm. long, about 1.5 mm. broad, obtusely angled, ascending on ascending pedicels 5–8 mm. long, with a distinct beak 3–5 mm. long, somewhat constricted between the seeds; cotyledons incumbent.

This species is probably nearest related to *E. asperimum* (*Cheiranthus asperrimus* Greene) but differs in the more elongated branches of the caudex or rootstock, which are covered with remnants of old leaves, the narrower perfectly entire leaves, the more slender stem, the less sharply angled pod and the more evident beak. The type was collected at Dawson by R. S. Williams, July 13, 1899.

Sophia sophiodes (Fisch.) Heller. Dawson (Williams).

Draba incana L. Lake Bennett (Tarleton).

Draba oligosperma Hook. Lake Bennett (Tarleton).

Draba aurea Vahl. White Horse Rapids (Tarleton).

Draba glacialis Adams. Lake Bennett (Tarleton).

Family DROSERACEAE.

Drosera rotundifolia L. Above Stewart River (Tarleton); Klondike (Williams).

Family SAXIFRAGACEAE.

Heuchera glabra Willd. Summit of White Pass (Williams).

Saxifraga tricuspidata Retz. Lebarge Island (Tarleton); Dawson and Miles Cañon (Williams).

Saxifraga reflexa Hook. Dawson (Williams).

Saxifraga pulvinata Small, sp. nov.

Perennial, deep green, densely tufted. Stems copiously branched, 3–10 cm. long: leaves numerous, crowded or approximate, often 4-ranked; blades oblong to broadly spatulate, 1.5–3 mm. long, leathery, ciliate, except at the thickened apex: flowering stems leafy at the base, naked above, gradually enlarged to the hypanthium: sepals softly glandular-pubescent when young, oblong, 2.5–3 mm. long, obtuse and green at the tip, longer than the hypanthium: corolla deep blue or purplish: petals 6–7 mm. long, the blades oval to nearly orbicular, minutely notched or toothed at the apex, the claws shorter than the blades: capsules 6–7 mm. high, the beaks erect, nearly as long as the body.

In dense tufts on the higher summits about Lake Bennett, (Tarleton, no. 11, June 6, 1899). Related to *Saxifraga oppositifolia* L., but differing in the smaller size, the markedly naked upper part of the flowering stems, the smaller turbinate hypanthium and the slender tips of the follicles.

Saxifraga galacifolia Small, sp. nov.

Perennial by horizontal rootstocks, glandular-pubescent throughout. Leaves basal or mainly so, few; blades membranous, ovate or orbicular-ovate, 5–8 cm. long, dentate or crenate-dentate, pale green beneath, deep green above; cor-

date, petioles as long as the blades or much longer: scapes erect, 2–4 dm. tall: panicle narrow, 5–15 cm. long, the branches erect or nearly so: pedicels glandular-pilose: sepals 2–2.5 mm. long, triangular-ovate, reflexed: corolla white; petals oblong to oblong-lanceolate, 3–5 mm. long, sometimes slightly accrescent: filaments filiform, longer than the petals: capsules 12–13 mm. high; follicles erect, nearly distinct.

Along mountain streams, near Indian River, August 3, 1899 (Tarleton, no. 176).

Related to *Saxifraga punctata* L.; but the leaves with blades manifestly longer than broad, the narrow panicle with its short branches and the lower leaf-like bracts, and the larger fruit are some of the characters which readily separate this species from its relative.

Chrysosplenium tetrandrum Fries. Klondike below Bonanza Creek (Williams); White Horse Rapids (Tarleton).

Family Parnassiaceae.

Parnassia palustris L. Walker Gulch (Williams); above Fort. Selkirk (Tarleton).

Parnassia Kotzebuei C. & S. Fort Selkirk and near Selwyn River (Tarleton).

Family Grossulariaceae.

Ribes rubrum L. Lindeman and Bonanza Creek (Williams).

Ribes Hudsonianum Richards. Near mouth of Bonanza Creek (Williams).

Ribes lacustre Poir. West Dawson (Williams).

Ribes irriguum Dougl. Five-finger Rapids (Tarleton).

Family Rosaceae.

Spiraea densiflora Nutt. Klondike-Indian Divide (Tarleton); Mouth of Bonanza (Williams).

Luetkea pectinata (Pursh) Kuntze. Summit of White Pass (Williams).

Potentilla Pennsylvanica L. Five-finger Rapids (Tarleton).

Potentilla nivea L. White Horse Rapids (Tarleton).

Potentilla Monspeliensis L. Dawson (Williams).

Comarum palustre L. Below Selwyn River (Tarleton); Klondike Bottom (Williams).

Argentina Anserina (L.) Rydb. Fort Selkirk (Tarleton); Dawson (Williams).

Fragaria Chiloensis Duchesne. Rink Rapids (Williams); Lake Lebarge (Tarleton).

Dasiphora fruticosa (L.) Rydb. Above Fort Selkirk (Tarleton); Dawson (Williams).

Rubus Chamaemorus L. Dawson (Williams); above Stewart River (Tarleton).

Rubus strigosus Michx. Dawson (Williams); above Stewart River (Tarleton).

Rubus arcticus L. Dawson (Williams); White Horse Rapids and below Sixty-mile Creek (Tarleton).

Rubus pedatus Smith. Bennett City and Skagway (Williams).

Geum Oregonense (Scheutz) Rydb. Fort Selkirk (Tarleton).

Dryas octopetala L. Dawson (Williams).

Dryas integrifolia Vahl. Dawson (Williams); Five-finger Rapids (Tarleton).

Sanguisorba officinalis L. Above Fort Selkirk (Tarleton).

Sanguisorba latifolia (Hook.) Coville. Bennett City (Williams).

Rosa acicularis Lindl. Five-finger Rapids (Tarleton); Dawson and near Thirty-mile River (Williams).

Family Pomaceae.

Amelanchier alnifolia Nutt. Dawson (Williams); White Horse Rapids (Tarleton).

Amelanchier florida Lindl. Miles Cañon (Williams).

Sorbus occidentalis (S. Wats.) Greene. Bennett City (Williams).

Family Papilionaceae.

Lupinus. An undescribed species named by Prof. C. V. Piper but not yet published. Dawson (Williams); Five-finger Rapids and foot of Lake Lebarge (Tarleton).

Astragalus debilis (Nutt.) A. Gray. Fort Selkirk (Tarleton).

Astragalus alpinus L. Near mouth of Klondike (Williams); White Horse Rapids (Tarleton).

Astragalus Williamsii Rydb. sp. nov.

Stem ascending or erect, 2–4 dm. high, more or less distinctly 4-angled, perfectly glabrous, light green or in age straw-colored; stipules ovate to narrowly lanceolate, 3–6 mm. long, free; leaves longer than the internodes, 5–10 cm. long; leaflets 9–11, elliptical to almost linear, 15–35 mm. long, 4–8 mm. wide, obtuse or retuse at the apex, perfectly glabrous; raceme at first short, in fruit elongating and about 1 dm. long, borne on a peduncle 1–1.5 dm. long; bracts oblong, obtuse, membranous, straw-colored, about 3 mm. long; pedicels short, 1–2 mm. long; calyx about 3 mm. long, black-hairy; lobes less than 1 mm. long, triangular obtuse; corolla yellow, except the purplish tip of the keel; banner about 1 cm. long, narrow, keel about 8 mm.; pod ascending, half membranous, oblong-ovate in outline, 10–14 mm. long and 4 mm. wide, glabrous, rounded at the base, acute at the apex; dorsal suture deeply sulcate for about two-thirds of its length and with a narrow partial partition, making the pod there deeply obcordate in section; the upper third not sulcate and with no indication of a partition; seeds about 4, brownish black.

A species perhaps referable to the *Oroboides*, but without any close relative in that group. Its small yellow flowers and peculiar fruit are characteristic.

The type was collected by R. S. Williams, near Big Salmon, August 22, 1899.

Astragalus Tarletonis Rydb.

Stem ascending, about 2 dm. high, angled, striate and sparingly strigulose: stipules lanceolate, attenuate, sparingly strigose, free from the petiole but somewhat united around the back of the stem: leaves about 1 dm. long, spreading; leaflets 17–29, elliptic to lanceolate, oblong, 10–15 mm. long, 3–6 mm. wide, sparingly strigose or in age glabrate, obtuse or retuse at the apex: spikes short and crowded, 3–4 cm. long on peduncles about 1 dm. in length: bracts oblong, 6–8 mm. long, mostly obtuse and black-hairy: calyx black-hairy; its tube about 6 mm. long; lobes linear subulate,

almost of the same length: corolla about 15 mm. long, purplish: fruit not seen.

This species is evidently closely related to *A. hypoglottis* L., but distinguished by its long slender calyx-lobes.

The type was collected by J. B. Tarleton at Five-finger Rapids, July 5, 1899 (no. 78).

Phaca Americana (Hook.) Rydb. Fort Selkirk (Tarleton; Williams).

PHACA LITTORALIS (Hook.) Rydb. (*Phaca frigida* γ *littoralis* Hook. Fl. Bor. Am. **2**: 140. 1840.) Five-finger Rapids (Tarleton).

Homalobus aboriginum (Richards.) Rydb. Miles Cañon (Williams); White Horse Rapids and foot of Lake Lebarge (Tarleton).

Homalobus tenellus (Pursh) Britton. Fifty miles above Stewart River (Tarleton).

Aragallus Richardsonii Greene. Above Fort Selkirk (Tarleton).

Aragallus varians Rydb., n. sp.

Cespitose perennial: leaves all basal, 1–2 dm. long, numerous: stipules lanceolate, scarious, long-acuminate, densely silky-villous, 1–2 cm. long: leaflets 30 or more, more or less verticillate, linear-oblong, silky-villous, obtuse, 1–2 cm. long, 3–4 mm. wide: scape about 2 dm. high, slender, terete, sparingly villous: spike short, 4–5 cm. long, dense: bracts linear-lanceolate, long-attenuate, about 1 cm. long, exceeding the calyx: calyx tube often dark, cylindrical, about 5 mm. long, silky-villous: lobes linear-subulate, 2–3 mm. long: corolla about 1 cm. long, yellow: fruit not seen.

Apparently related to *A. Richardsonii* and *A. splendens*, but easily distinguished by its yellow flowers and the fact that the leaflets are not always verticillate.

The type was collected by J. B. Tarleton on Lewis River, June 28, 1899 (no. 33b).

Aragallus viscidus (Nutt.) Greene. White Horse Rapids (Tarleton).

Aragallus viscidulus Rydb. Near Selkirk (Williams).

Aragallus podocarpus (A. Gray) Greene. Lake Bennett, near summit of "Pinnacle" (Tarleton).

Aragallus deflexus (DC.) Heller. Five-finger Rapid Tarleton.

Aragallus. Species not determined; nearly related to *A. Lambertii.* Lewis River (Tarleton).

Hedysarum Americanum (Michx.) Britton. Near mouth of Klondike (Williams); Five-finger Rapids (Tarleton).

Hedysarum Mackenzii Richards. Five-finger Rapids (Tarleton).

Family Linaceae.

Linum Lewisii Pursh. Lake Lebarge (Tarleton).

Family Callitrichaceae.

Callitriche palustris L.? On mud, Klondike bottom (Williams). A small form with bracts very small or wanting.

Family Empetraceae.

Empetrum nigrum L. Lindeman (Williams); Fort Selkirk (Tarleton).

Family Violaceae.

Viola palustris L. White Horse Rapids (Tarleton); Upper Walker Gulch (Williams).?

Family Elaeagnaceae.

Lepargyraea Canadensis (L.) Greene. Dawson (Williams); Lake Bennett and above Fort Selkirk (Tarleton).

Family Onagraceae.

Chamaenerion angustifolium (L.) Scop. Dawson (Williams); above Fort Selkirk (Tarleton).

Chamaenerion latifolium (L.) Sweet. Five-finger Rapids (Tarleton); Thirty Mile River (Williams).

Epilobium palustre L. Dawson (Williams). The *E. palustre albiflora* Hook., differing from the type by its narrower leaves and pale flowers.

Family Halorragidaceae.

Hippuris vulgaris L. Island below Stewart River (Tarleton).

Family UMBELLIFERAE.

Selinum Dawsoni Coult. & Rose. Dawson (Williams).

Cicuta virosa L. Pond, Klondike bottom (Williams).

Bupleurum Americanum Coult. & Rose. Near Selkirk (Williams).

Family CORNACEAE.

Cornus Canadensis L. Dawson and near mouth of Klondike (Williams); above Fort Selkirk (Tarleton).

Cornus stolonifera Michx. Five-finger Rapids (Tarleton); Dawson (Williams). Leaves not so white beneath as in the eastern plant.

Family PYROLACEAE.

Pyrola uliginosa Torr. Below Selwyn River (Tarleton).

Pyrola secunda L. Dawson (Williams).

Pyrola secunda pumila Paine. Walker's Gulch (Williams); above Fort Selkirk (Tarleton).

Pyrola bracteata Hook. Below Selwyn River (Tarleton); Dawson (Williams).

Moneses uniflora (L.) A. Gray. Walker Gulch (Williams); Fort Selkirk (Tarleton).

Family ERICACEAE.

Ledum Groenlandicum Oeder. Along river above Dawson (Williams); above Stewart River and above Fort Selkirk (Tarleton).

Ledum decumbens (Ait.) Lodd. High ridge above Lindeman (Williams); Bonanza Creek (Tarleton). Apparently distinct from *L. palustre* L.

Kalmia microphylla (Hook.) Heller. Bennett (Williams).

Andromeda Polifolia L. Dawson (Williams); below Stewart River (Tarleton).

Chamaedaphne calyculata (L.) Moench. Dawson swamp (Williams).

Chamaecistus procumbens (L.) Kuntze. Above Lindeman (Williams).

Phyllodoce glanduliflora (Hook.) Coville. Lindeman and summit of White Pass (Williams).

Phyllodoce empetriformis (Smith) Don. Lindeman (Williams).

Cassiope Stelleriana (Pall.) DC. Above Lindeman and summit of White Pass (Williams).

Cassiope Mertensiana (Bong.) Don. Above Lindeman, and summit of White Pass (Williams).

Cassiope tetragona (L.) Don. Above Lindeman (Williams); Lake Bennett (Tarleton).

Arctostaphylos Uva-Ursi (L.) Spreng. Dawson (Williams); Lake Bennett (Tarleton).

Mairania alpina (L.) Desv. Dawson and near Selkirk (Williams); Lake Bennett and Klondike Indian Divide (Tarleton). The red-fruited form collected also by Tarleton below Selwyn River.

Family VACCINIACEAE.

Vaccinium uliginosum L. Dawson (Williams); below Selwyn River (Tarleton).

Vitis-Idaea Vitis-Idaea (L.) Britton. (*Vaccinium Vitis-Idaea* L.) Lindeman and Little Salmon River (Williams); Lake Lebarge (Tarleton). The recognition of the genera *Batodendron* and *Polydodium* as segregates from the complex *Vaccinium* of previous authors requires, it seems to me, the separation also of *Vitis-Idaea*, as was maintained by Tournefort, and since the Linnaean period by Moench.

Oxycoccus Oxycoccus (L.) MacM. Dawson (Williams); below Selwyn River (Tarleton).

Family PRIMULACEAE.

Primula Sibirica Jacq. Lebarge Island (Tarleton); on clayey shore, Lebarge (Williams).

Primula stricta Hornem. Five-finger Rapids (Tarleton, no. 73), apparently identical with specimens from Scandinavia.

Androsace septentrionalis L. Dawson and Rink Rapids (Williams).

Androsace Gormani Greene? Lake Bennett (Tarleton).

Trientalis arctica Fisch. Summit of White Pass, and below Bonanza (Williams).

Dodecatheon frigidum C. & S. Stream by West Dawson (Williams).

Family GENTIANACEAE.

GENTIANA HOLOPETALA (A. Gray) Rydb. (*G. serrata holopetala* A. Gray). Above Fort Selkirk (Tarleton).

Gentiana propinqua Richards. Dawson (Williams); Fort Selkirk (Tarleton).

Family MENYANTHACEAE.

Menyanthes trifoliata L. Ponds, Klondike bottom (Williams); Sixty Mile Creek (Tarleton).

Family APOCYNACEAE.

Apocynum androsaemifolium L. Dawson (Williams). A low pubescent form, perhaps referable to *A. androsaemifolium incanum* DC.

Family POLEMONIACEAE.

Polemonium occidentale Greene. Dawson (Williams); hills around Dawson and at Fort Selkirk (Tarleton).

Polemonium pulchellum Bunge. White Horse Rapids (Tarleton); Dawson (Williams).

Gilia capitata Dougl. Dawson, introduced (Williams).

Family HYDROPHYLLACEAE.

Phacelia. A species related to *P. Lyallii* (A. Gray) Rydb., but villous all over. Collected only in fruit. Below Selwyn River (Tarleton).

Family BORAGINACEAE.

Lappula. Specimens in flower only. White Horse Rapids and Lebarge Island (Tarleton).

Lappula Redowskii (Hornem.) Greene. Near Rink Rapids (Williams).

Mertensia paniculata (Ait.) Don. Lebarge (Williams); Five-finger Rapids (Tarleton).

Mertensia Alaskana Britton, sp. nov.

Similiar to *M. paniculata*, 5 dm. high, or more. Stem and branches glabrous; pedicels 1–3 cm. long, very slender, appressed-pubescent with whitish hairs: leaves papillose-pubescent above, sparingly pubescent or glabrous beneath, the lower oblanceolate, 6–10 cm. long, acute, with margined petioles, the middle ones oblong-lanceolate, sessile, the upper lanceolate, acuminate: corolla 1.5 cm. long, the limb about the length of the tube: calyx 5–6 mm. long, cleft nearly to the base, the lobes lanceolate, acuminate, bristly-ciliate, otherwise glabrous or very nearly so; style not exserted.

Fort Yukon, Alaska, Antoine Soule, 1865 (type); Dawson (Williams), a white-flowered form; Mackenzie's River, Onion, Kennicott and Hardisty, 1861–62.

Family Labiatae.

Dracocephalum parviflorum Nutt. Dawson (Williams); Fort Selkirk (Tarleton).

Family Scrophulariaceae.

Veronica alpina L. Summit of White Pass (Williams).

Pentstemon cristatus Nutt. Five-finger Rapids (Williams; Tarleton); Lake Lebarge (Tarleton).

Euphrasia Americana Wetts. River bank above Fort Selkirk (Tarleton).

Castilleja pallida (L.) Kunth. Above Dawson (Williams); above Fort Selkirk, near Indian River, and Five-finger Rapids (Tarleton). Mr. Tarleton's specimens from above Fort Selkirk and Five-finger Rapids (nos. 80 and 80b) differ from the others in being villous to the base and may represent another species.

Pedicularis euphrasioides Stephan. Dawson and mouth of Bonanza (Williams); Five-finger Rapids (Tarleton).

Pedicularis Sudetica Willd. Five-finger Rapids (Tarleton).

Family Orobanchaceae.

Thalesia fasciculata (Nutt.) Britton. Fort Selkirk (Tarleton).

Boschniakia glabra C. A. Meyer. Dawson (Williams); Selwyn River (Tarleton).

Family LENTIBULARIACEAE.

Pinguicula villosa L. Dawson (Williams); below Selwyn River (Tarleton).

Utricularia vulgaris L. Sixty Mile Creek (Tarleton).

Family PLANTAGINACEAE.

Plantago aristata Michx. Dawson (Williams).

Plantago septata E. L. Morris, sp. nov.

A bright green, acaulescent perennial, with one tap-root and with the bases of the leaves of the preceding year persistent, generally cinereous-woolly, most of the hairs under a lens flattened and distinctly 3–9-septate or even articulate. Leaves crowded, erect or spreading, several, narrowly lanceolate, acute or obtuse at the apex, entire, narrowed to the more or less margined semi-clasping petiole, about 140 mm. by 15 mm., 5-nerved in blade and petiole, very woolly at the base and on the petiole; scapes basal, erect or ascending, stout, terete and striate, several, equalling or surpassing the leaves, about 150 mm. high, woolly below, pubescent above; spikes erect, long-cylindrical, about 50 mm. by 5 mm., in fruit somewhat loose, their axes pubescent; bracts brown-herbaceous, with wide scarious margins, in fruit keeled, nearly equalling the calyx, ovate to round-ovate, obtuse and delicately fimbriolate, about 2 mm. by 2 mm., glabrous; flowers numerous, perfect, glabrous; divisions of the calyx scarious, with brown-herbaceous midribs, broadly obovate, rounded, 2 mm. long; corolla tube just equalling the calyx, its lobes, spreading, broadly oblong, obtuse and often abruptly apiculate, nearly 1.5 mm. by 1 mm., white; stamens four, and, with the filiform stigma, long-exserted; pyxis finely reticulate, two times as long as the calyx, oblong, rounded at the apex, circumscissile at the lower third; seeds two, black.

Type specimen, collected by R. S. Williams, near Little Salmon, Yukon Territory, August 22, 1899.

Family RUBIACEAE.

Galium boreale L. Five-finger Rapids (Tarleton); Dawson (Williams).

Family Caprifoliaceae.

Viburnum pauciflorum Pylaie. Dawson and Miles Cañon (Williams); Five-finger Rapids (Tarleton).

Linnaea Americana Forbes. Walker Gulch (Williams); Five-finger Rapids (Tarleton). This North American plant appears to differ constantly from the European *L. borealis* in its funnelform, not campanulate corolla.

Family Valerianaceae.

Valeriana bracteosa Britton, sp. nov.

Similar to *V. sylvatica* and *V. uliginosa*, about 4 dm. high, slightly pubescent at the nodes, otherwise glabrous. Rootstock slender, horizontal; lower and basal leaves oval, entire, petioled; upper leaves about 3 pairs, sessile, with 3 lanceolate acuminate few-toothed segments, or those of the uppermost pair entire: cyme open, its branches filiform; bracts very narrowly linear, black, much longer than the fruit: calyx-lobes united near the base into a black cup, loosely plumose: corolla 5–6 mm. long, its tube about equalling the throat and limb.

Type collected by R. S. Williams at Dawson, July 14, 1899; also collected by Tarleton above Fort Selkirk, July 12, 1899, no. 101a and 101b.

Family Campanulaceae.

Campanula lasiocarpa Cham. White Pass (Williams); the Dome, Klondike-Indian Divide (Tarleton).

Campanula aurita Greene. This species is closely related to *Campanula expansa* Rudolph, of Siberia, which has been referred by Ledebour to the *Wahlenbergia homallanthina* of De Candolle. Both plants agree in having a rotate deeply divided corolla and a strongly upcurved style. It does not seem to me that they are properly referable to the Old World genus *Wahlenbergia*. In the characters of style and corolla they resemble the East American *Campanula Americana* L.

Dawson (R. S. Williams, July 29, 1899); also collected by Tarleton at Dawson, Aug. 19, 1899, no. 185a and 185b.

Family Cichoriaceae.

Taraxacum ceratophorum DC. Five-finger Rapids (Tarleton).

Crepis elegans Hook. River bank opposite Dawson (Williams). Specimens with lyrate-pinnatifid lower leaves.

Hieracium gracile Hook. Bennett City (Williams).

Hieracium triste Cham. White Pass (Williams).

Hieracium albiflorum Hook. Bennett City (Williams).

Family Compositae.

Solidago multiradiata Ait. Dawson (Williams); Fort Selkirk (Tarleton).

Solidago elongata Nutt. Fifty miles above Stewart River (Tarleton).

Solidago oreophila Rydb. Dawson (Williams); Fort Selkirk and fifty miles above Stewart River (Tarleton).

Stenotus borealis Rydb., sp. nov.

Depressed cespitose, branches 3–6 cm. long, densely covered with the leaves, which are narrowly linear, almost filiform, 10–18 mm. long and .5–.7 mm. wide, hispid ciliate on the margin and with a strong rib: peduncles naked, 4–5 cm. long, puberulent and glandular especially above: head about 1 cm. high: bracts subequal in two series, linear lanceolate, acute, thin, puberulent and somewhat glandular, yellowish green: rays about 1 cm. long and 3–4 mm. wide, obtuse or truncate and entire at the apex: pappus tawny white.

This species is nearest related to *S. stenophyllus* (A. Gray) Greene, but the latter has thicker bracts and its leaves are glandular puberulent all over, while in *S. borealis* the leaves are devoid of glands, perfectly glabrous except the ciliolate margin. Foot of Lake Lebarge (J. B. Tarleton, 51).

Aster giganteus (Hook.) Rydb. (*Aster Richardsonii giganteus* Hook. Fl. Bor. Am. **2**: 7. 1840.) Near mouth of Klondike and at Dawson (Williams); Five-finger Rapids (Tarleton).

Aster Unalaschensis Less. The same as the specimen in the Columbia Herbarium from Unalaska, named by Bongard.

White Pass (Williams). The species is referred by Gray to *Aster peregrinus* Pursh, and if correctly, this is the older name for it.

Erigeron acris L. Above Fort Selkirk (Tarleton); Dawson (Williams).

Erigeron Yukonensis Rydb. sp. nov.

Perennial with horizontal rootstock. Stems usually more than one, ascending, about 2 dm. high, more or less hirsute: basal leaves linear-oblanceolate, 3–10 cm. long, acute or acuminate at the apex, below tapering into a short winged petiole, more or less hirsute on both sides and ciliate on the margin; lower stem leaves linear and short-petioled, the upper linear-lanceolate, sessile, 2–3 cm. long: heads 1–3, solitary at the end of the stem or the few elongated branches: involucre about 15 mm. in diameter, white-hirsute, bracts very narrowly linear-subulate, long-attenuate, with the loose tips slightly exceeding the disk; rays very numerous, bluish-purple, about 12 mm. long and less than 1 mm. wide.

In general habit, this species resembles most *E. Eatonii*, but the size of the head and the numerous narrow rays suggest *E. macranthus* and the hairiness of the involucre *E. simplex*. The type was collected by R. S. Williams at Dawson, July 23, 1899.

Erigeron multifidus Rydb. Lebarge Island (Tarleton).

Erigeron caespitosus Nutt. Near Little Salmon River (Williams).

Erigeron grandiflorus Hook. Fort Selkirk (Tarleton).

Erigeron Turneri Greene. Five-finger Rapids (Tarleton).

Antennaria pulcherrima (Hook.) Greene. Lower Thirty Mile River (Williams).

Antennaria parvifolia Nutt. Lower Thirty Mile River (Williams); Five-finger Rapids (Tarleton).

Anthemis Cotula L. Dawson, introduced (Williams).

Achillea lanulosa Nutt. Dawson (Williams); above Fort Selkirk (Tarleton).

Tanacetum Huronense Nutt. River bank opposite Dawson (Williams); Fort Selkirk (Tarleton). Specimens with dark brown involucral bracts.

Artemisia laciniata Willd. Sp. Pl. 3: 1843. Above Fort Selkirk (Tarleton, no. 111).

This specimen agrees with Karelin and Kiriloff's no. 705, determined as *A. laciniata glabriuscula* Ledeb., from Narym, Siberia. This is cited by Ledebour, Fl. Ross. 2: 582, as variety *a* of the species. It also answers to the description of the species, and to the left hand figure of Gmelin's Fl. Sib. 2: *pl. 57*, except that the heads are a little larger. The species has not hitherto been reported from America; it is said in Kew Index to occur also in the Himalayas.

Artemisia elatior (T. & G.) Rydb. Fifty miles below Stewart River (Tarleton); Dawson (Williams).

Artemisia Canadensis Michx. Selkirk (Williams).

Artemisia frigida Willd. Dawson (Tarleton); near Little Salmon River (Williams).

Artemisia longipedunculata Rudolph. White Pass (Williams).

Petasites frigida (L.) Fries? Lake Bennett (Tarleton). Dawson Swamp (Williams). Mr. Tarleton's specimens differ from the typical European plant in having much more deeply lobed leaves.

Petasites gracilis Britton, sp. nov.

Scape slender, about 4 dm. high, sparingly lanate. Leaves thin, broadly ovate, subcordate, loosely lanate beneath, 5–6 cm. broad, with about twelve large acute cuspidate teeth or short lobes, the sinuses rounded; petiole slender, twice as long as the blade; scales of the scape and bracts of the inflorescence lanceolate, acuminate: inflorescence racemose, about 1 dm. long: peduncles very slender, glandular-pubescent, 2–5 cm. long: involucre glandular-pubescent, its linear-oblong obtuse bracts about half the length of the bright white pappus, the few outer bracts much shorter.

Walker Gulch, Williams, July 16, 1899.

Arnica angustifolia Vahl. Dawson (Williams); Lebarge Island (Tarleton). Differing from typical specimens of this species by having three long-peduncled flower-heads.

Senecio frigidus Less. Dawson (Williams).

Senecio lugens Richards. Above Fort Selkirk (Tarleton); Dawson (Williams).

Senecio saliens Rydb. Bennett City (Williams).

Senecio discoideus (Hook.) Britton. Dawson (Williams); Fort Selkirk (Tarleton). One of the specimens with rays.

Saussurea nuda Ledeb. Walker Gulch (Williams); below Stewart River (Tarleton, 168; 168b).

These specimens are the same as one of *S. alpina remotiflora* Hook., received by Dr. Torrey from Dr. Hooker, and preserved in the Columbia University Herbarium. This variety of Hooker is referred by Ledebour in Flora Rossica to his *S. nuda*. It differs, however, in its much narrower leaves, and may be a distinct species.

The Oaks of the Continental Divide north of Mexico.

By P. A. Rydberg.

All the oaks of Colorado have lately been referred to only two species, *Quercus undulata* and *Q. Gambelii*. Mr. F. K. Vreeland and I spent a portion of last summer in the southern part of that State, and in studying the oaks in the field we came to the conclusion that those of the regions visited must belong to five or six species. The differences were manifest even early in the spring when the leaves unfolded. In the Cuchara valley around La Veta scrub-oaks are very common. They usually grow in large clumps often 20–30 m. in diameter. The roots of several of the species grow horizontally, close below the surface of the ground and send up numerous shoots. These oaks also fruit very early, often before they are a meter high; therefore, when a young oak has started in a place, there soon grows up around it a whole colony of still younger ones. As the youngest on the periphery of the clump have more light and air, they grow faster and soon overtake those in the center, and consequently the small trees of the colony quite often have the same height (1–5 m.) as if they were trimmed with a gardener's clipper. In rocky

ground the colonies are more irregular and shrub-like. When the leaves unfold in the spring the contrast between the clumps of the different species or subspecies, as you may call them, is best shown, as one clump is bright red, while the next may be yellowish or gray. One of the yellow forms I afterwards identified as *Q. Gambelii* Nutt. and the gray one is *Q. Fendleri* Liebm.

In the South Cheyenne Cañon, near Colorado Springs, in Wahatoga Cañon between the two Spanish peaks and on Turkey Creek, a tributary of Huerfano River, we also found oaks but of a different habit, viz., solitary, middle-sized trees, that could scarcely be referred to *Q. Gambelii*. Those of the last locality, at least, were so unlike any of the forms included in *Q. Gambelii*, that I immediately regarded them as belonging to an undescribed species; the thin leaves and general habit suggest rather *Q. minor*.

When I left I instructed Mr. Vreeland to collect acorns in the fall. He has sent me specimens of three or perhaps four distinct forms of the *Q. Gambelii* series. We may call them species or varieties just as we please, but they look very different in the field—more so than in herbarium specimens. Besides these I had notes and material gathered by myself in 1895, by Dr. Fred. Clements, of Nebraska, and Mr. E. A. Bessey, of Washington, D. C., in the years 1896–1900, and of course the specimens in the herbaria of New York Botanical Garden and Columbia University. I found, however, that these collections were not sufficient to make a thorough study of the oaks of the southern Rockies. I wrote to the Missouri Botanical Garden and the United States National Herbarium, asking for the loan of their specimens of *Q. undulata*, *Q. Gambelii* and related species. These requests were kindly granted.

My original intention was to confine my study to the oaks of the Rockies proper, but I found that in order to reach a satisfactory understanding of these, it was necessary to take into consideration the nearly related forms of the plains and table-lands of Arizona, New Mexico and western Texas. I

therefore changed my plan, and the area covered in the present paper comprises the States of Arizona, New Mexico, Colorado, Utah, Wyoming, southern Idaho, and that portion of Texas which is west of the mouth of Pecos River or approximately longitude 101°. There are no oaks in the Canadian Rockies nor in Montana * nor northern Idaho. Another oak not included in this paper, viz., *Q. acuminata*, is said to occur in the Guadalupe Mountains of western Texas. This has been omitted as I lack both specimens and reliable information concerning its occurrence there.

In working up the material, I very naturally turned to Professor Sargent's elaborate work, "The Silva of North America," expecting to find there most that I needed in the way of literature. I was rather disappointed, however. The drawings are excellent, the descriptions are profuse; but the key is almost useless at least as far as the Rocky Mountain species are concerned; the limitation of species is in many cases, in my opinion, too broad and too confusing, and the treatments of such men as Liebman, Alphonse DeCandolle, Engelmann and Greene are often simply disregarded. If we add hereto notes made on the herbarium sheets, in the easily accessible collections of Columbia, Missouri Botanical Garden, and the National Herbarium, by men like Engelmann, Greene, Wright, Wooton, Toumey, Wilcox and Havard, who spent years in the region from central Texas to the Colorado of the West, it is strange that such a pretentious work as the Silva should lack so much of definite information from these field botanists and their views. The broad descriptions of *Quercus undulata* and *Q. Gambelii* may cover all the forms included therein by Professor Sargent, but does it not produce confusion rather than clearness to enumerate a great number of supposed synonyms, without in any way indicating what these represent?

* I have seen no specimens of *Q. macrocarpa* from Montana, nor the citation of any specific locality in the State where it grows. There are some vague references to its existence in the southeastern corner of that State, however, which is not improbable, as it grows in the neighboring Black Hills of Wyoming and South Dakota.

And as to the plates, I stated that they are excellent. They are so as far as the drawing, engraving and printing are concerned. For the deficiencies that are to be found in them the botanist alone is responsible. The confusion of species in his mind is shown in the selection of material for the illustrations. Take for an example the plate of *Q. undulata* (Pl. 385). Anyone can see that the figures there given represent more than one species. In fact, leaves of not less than six species are there illustrated, and not one of these is *Q. undulata* Torr., unless Fig. 4 is meant to represent it. This figure, however, does not give a good illustration of the typical form; if this is interpreted as *Q. undulata* it makes the seventh species illustrated on the plate.*

Quercus Gambelii has in the Silva the following synonyms: *Q. Gambelii* Nutt., *Q. alba β? Gunnisonii* Torr., *Q. stellata δ Utahensis* A. DC., *Q. Douglasii β? Gambelii* A. DC., *Q. Douglasii γ Novomexicana* A. DC., *Q. undulata* Wats., *Q. undulata α Gambelii* Engelm., *Q. Gambelii* var. *Gunnisonii* Wenzig, and *Q. venustula* Greene. Let us see what they represent.

Quercus Gambelii Nutt.† was based on specimens collected on the Rio del Norte by Gambel, the exact locality is not stated. It is described as follows: "Leaves obovate, shortly petioled, narrowed below, sinuately lobed, dilated and somewhat 3-lobed at the summit, beneath pubescent, the lobes rather obtuse, the upper subdentate; fruit sessile, small, the cup hemispherical, scales ovate-acute; the glands ovate and acute, about half immersed in the cup; the conic summit short."

The oak that I take to be typical, and the only one that has an acute acorn, half immersed in the cup, and "sinuately lobed" leaves is not the most common one of the *Q. Gambelii* series. It is found, as far as I know, only in Colorado and New Mexico, and was collected by Mr. Vreeland and myself

* These are: *Q. undulata* Torr. (?) *f. 1, 4; Q. pungens* Liebm. *f. 5; Q. Fendleri* Liebm. *f. 6–8; Q. grisea* Liebm. *f. 9; Q. turbinella* Greene, *f. 10–12; Q. undulata* var. *obtusifolia* A. DC. *f. 13; Q. venustula* Greene, *f. 14*.

† Journ. Phil. Acad. II. 2: 179. 1848.

in flower and by him in fruit. Its leaves are usually neither very dark green nor very shining above, pale and finely puberulent beneath, obovate in outline, seldom lobed much deeper than halfway to the midrib and with rounded lobes. The cup is hemispherical or somewhat turbinate and 12–15 mm. in diameter, the acorn about 15 mm. long and acute ovoid. Neither Sargent's nor Greene's figures give a good illustration of it.

The description of *Q. Gambelii* by Liebman* differs considerably from that of Nuttall, especially the following statements, "foliis * * * profunde sinuato-pinnatifidis, * * * subtus incanis pubescentibus * * * glande globosa, apiculata," do not well agree with Nuttall's diagnosis. Liebman does not claim that he had Nuttall's plant, for he published it as *Q. Gambelii* Liebm. Neither is it evident that the plate published after Liebman's death by Oersted was drawn from Gambel's plant, although Liebman states that he had seen a specimen collected by Gambel. I have seen a specimen of Fendler's no. 806, which Liebman also includes, and this matches exactly the plate referred to above. It also agrees fully with Liebman's description. Fendler's no. 806 represents a specimen of an oak described under the name of *Q. stellata Utahensis* by Alphonse DeCandolle, but with leaves that are a little more deeply pinnatifid than usual. See below.

Quercus alba β Gunnisonii Torr.† generally has narrower leaves. In the type they are almost oblong in outline and with rounded lobes directed forward, but in specimens from Colorado which I refer here they are broader and obovate and resemble those of *Q. Gambelii*, but are firmer, paler and bluish above and pubescent but green beneath. The fruit is different, the cup being larger, often over 15 mm. The acorn is barrel-shaped, and obtuse or even depressed at the apex. Sargent's Pl. 368, Fig. 5 is a good figure of the acorn, but none of the leaves are an exact illustration.

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* Overs. Dansk. Vidensk. Selsk. Forhandl. 1854: 169.

† Pac. R. R. Rep. 2^1: 130. 1855.

Quercus stellata δ Utahensis A. DC.* as I understand it is a species quite common in Arizona and Utah, but also found in New Mexico. It is characterized by its very broad, obovate leaves, which are deeply lobed, *i. e.*, three-fourths or two-thirds to the midrib and densely and softly pubescent, almost velvety beneath, dark green and shining above. The fruit is much larger than in *Q. Gambelii*, the cup being 15–18 mm. in diameter. The acorn is ellipsoid or barrel-shaped, obtuse or truncate at the apex, 15–20 mm. long.

Quercus Douglasii β? Gambelii A. DC.† is the same as *Q. Gambelii* Nutt. and of Liebm.

Quercus Douglasii γ Novomexicana A. DC.‡ was based on Fendler's nos. 890, 810 and 810b. The first number has well developed leaves, the others are in flower; the leaves much more deeply divided than in *Q. Gambelii*, *i. e.*, to near the midrib and the lobes are acutish. The fruit is of about the same size as in that species, but the acorn is more barrel-shaped and rounded at the apex. This oak is very common in Colorado and New Mexico, but also found in Arizona and Utah.

Quercus undulata Wats.§ comprises all the forms included by Professor Sargent in *Q. Gambelii* and *Q. undulata*.

Quercus undulata α Gambelii Engelm.‖ comprises *Quercus Gambelii* Nutt., *Q. Douglasii γ Novomexicana* A. DC. and perhaps other forms of this series.

Quercus Gambelii var. *Gunnisonii* Wenzig¶ is the same as *Q. alba Gunnisonii* Torr.

Quercus venustula Greene** has been misunderstood by Professor Sargent. In a footnote on page 34 of volume 8 of the Silva, the latter states that Pl. 367, Fig. 3 represents a leaf of this species. By comparing this with Greene's illus-

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* Prod. 16[2]: 22. 1864.

† Prod. 16[2]: 23. 1864.

‡ Prod. 16[2]: 24. 1864.

§ Am. Nat. 7: 302. 1873.

‖ Trans. St. Louis Acad. 3: 382. 1876.

¶ Jahrb. Bot. Gart. Berlin 3: 190. 1884.

** West Amer. Oaks 2: 69. 1890.

trations, Pl. 32 of the West American Oaks, anybody can see that they are not the same. I think that the leaf, from which Fig. 14 of *Q. undulata*, Pl. 385, was drawn was taken from a specimen of *Q. venustula*. *Quercus venustula* is in every respect nearest to *Q. Fendleri* Liebm. and should therefore have been included in *Q. undulata* according to Professor Sargent's view of that species. *Q. venustula* differs from *Q. Fendleri* only in one respect, viz.: the narrower more obtuse lobes of the leaves. I have seen no specimens of *Q. venustula* except three sheets of Greene's original collection. These agree perfectly with each other and with Greene's illustration.

Under *Q. undulata* we find in Sargent's Silva the following synonyms: *Q. undulata* Torr., *Q. Fendleri* Liebm., *Q. grisea* Liebm., *Q. pungens* Liebm., *Q. oblongifolia* Torr. (Mex. Bound. Surv.; not Sitgreave's Rep.), *Q. undulata* β *obtusifolia* A. DC., *Q. undulata* γ *pedunculata* A. DC., *Q. Emoryi* Porter & Coulter, *Q. undulata* γ *Jamesii* Engelm., *Q. undulata* δ *Wrightii* Engelm., *Q. undulata* var. *pungens* Engelm., *Q. undulata* var. *grisea* Engelm., *Q. undulata* var. *oblongata* Engelm., *Q. turbinella* Greene (in part).

If all the plants represented by these names constitute one species, we can not consistently let *Q. Engelmannii* stand distinct from *Q. oblongifolia*, nor *Q. Arizonica* from *Q. reticulata*, nor *Q. Toumeyi* from *Q. dumosa*. In fact we must reduce all these species to *Q. undulata*, for both *Q. oblongifolia* and *Q. Arizonica* are indeed too close to *Q. grisea* in the list above. Let us see, therefore, what the cited synonyms represent.

Q. undulata Torr.,* as represented by Dr. James' plant, many specimens from Texas and a few from Colorado, New Mexico and Arizona, has oblong oval leaves, 4–5 dm. long, firm and apparently more or less persistent, pale bluish green and shining above, light brownish, stellate-puberulent and distinctly reticulate beneath, sinuately dentate with sharp mucronate but not spinulose-tipped teeth, acute at the apex and

* Ann. Lyc. N. Y. **2**: 248. 1828.

rounded at the base. The acorn mounted on the type sheet and figured by Dr. Torrey does not belong to this species, but other specimens give the character of the fruit. The cup is hemispherical, 6–8 mm. in diameter and with short scales thickened on the back; the acorn is almost cylindrical or barrel-shaped, obtuse or acute, about 10–15 mm. long. None of Sargent's figures is a good illustration of the true *Q. undulata;* if the size and form of the leaves of Fig. 4 is combined with the toothing of Fig. 10, a fair idea may be had of the usual form; the acorn is too short and too much tapering.

Quercus Fendleri Liebman * as represented by the type, *Fendler, 805*, and numerous specimens from Colorado and New Mexico, is I think a fairly good species. The leaves somewhat resemble those of *Q. undulata* but are distinctly lobed, with triangular lobes pointed forward, not spinulose tipped. They are usually much thinner than those of *Q. undulata.* They are tardily deciduous, as I have myself seen, and not evergreen as those of several other forms included in *Q. undulata* by Professor Sargent. Professor Greene's figure, Pl. 31, is excellent and his remarks about duration of the leaves and differences from *Q. undulata* ought to have called Professor Sargent's attention to their distinctness, even if *Q. Fendleri* is to be regarded only as a variety. The fruit is, however, much larger and different in shape. The cup is 10–15 mm. in diameter. The acorn is thicker but scarcely longer than in the preceding, less cylindrical and more tapering at the apex. Sargent's Pl. 385, Fig. 15 is a good representation. Figs. 6 and 7 represent the leaves, but the lobes are generally more acute and longer. Fig. 8 illustrates the leaf of a young shoot.

Fendler's No. 808, which is the type of *Q. undulata γ pedunculata* A.DC., I refer here, although the leaves have peculiar cordate bases. The number referred to is represented in the Engelmann herbarium by a young shoot, in which the leaves nearly always adopt queer shapes. Young shoots of *Q. un-*

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*Oversigt Dansk. Vidensk. Selsk. Forhandl. 1854: 171.

dulata often have leaves that strikingly resemble the usual leaves of *Q. Fendleri.*

Quercus grisea Liebman* as represented by the type, *Wright, 665*, and by his *1866* also cited by DeCandolle, has small oval, entire leaves, which are only 2–3 cm. long, thick, evidently persistent and so described, densely stellate-tomentose and more reticulate beneath. In fact they are intermediate between those of *Q. Arizonica* and *Q. oblongifolia* but smaller than in either. To me there is no doubt that it is distinct from *Q. undulata;* the cup is shallower than in the two preceding and 10–12 mm. in diameter; the acorn is like that of *Q. Fendleri* and not of the nearer related *Q. undulata.* Sargent's Pl. 385, Fig. 9 represents a leaf of this species.

Quercus pungens Liebman,† the type of which is *Wright, 664*, is much closer to *Q. undulata* than any of the preceding, differing in the deeper lobing of the leaves, their somewhat firmer texture and the evident spinulose tips. Usually the leaves are also decidedly undulate-crisped with the lobes bent or twisted. The acorn resembles that of *Q. undulata*, but is often somewhat thicker; the cup is shallower, and often 1 cm. wide.

Quercus oblongifolia Torr. in the Mexican Boundary Survey is the same as *Q. grisea* Liebman, except Parry's specimen, which probably belongs to *Q. Engelmannii* Greene.

Quercus undulata obtusifolia A. DC.‡ is a peculiar oak combining the texture, pubescence, veining and color of the leaves of the *Q. undulata* series with the lobing and form of some members of the *Gambelii* group and *Q. breviloba.* The leaves differ from a broad-leaved form of the latter only in the thicker texture and a more prominent pubescence. To refer this oak to *Q. undulata* is scarcely admissible. The type, Fendler's no. 807 has no fruit; but very similar specimens have been collected by Dr. Havard, and in these the cup is

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* Oversigt Dansk. Vidensk. Selsk. Forhandl. 1854: 171.

† Oversigt Dansk. Vidensk. Selsk. Forhandl. 1854: 171.

‡ Prod. 16^2: 23. 1864.

16–18 mm. in diameter and the acorn ellipsoid, over 2 cm. long and about 16 mm. broad. Sargent's Pl. 385, Fig. 13, represents this species. It may be remarked here that *Q. undulata* of DeCandolle's Prodromus is not *Q. undulata* Torr., but *Q. Fendleri* Lieb. This explains why Alphonse DeCandolle associated *obtusifolia* with *Q. undulata*.

Quercus undulata γ pedunculata A. DC.* See *Q. Fendleri* above.

Quercus Emoryi Porter & Coulter † (not Torr.), was based on specimens collected by Brandegee at Cañon City. The original I have not seen, but others collected by him at the same place later and named *Q. Emoryi* belong to *Q. pungens* Liebm.

Quercus undulata γ Jamesii Engelm.‡ is the typical *Q. undulata* and based on the type.

Quercus undulata δ Wrightii Engelm. l. c. and

Quercus undulata var. *pungens* Engelm. § are both *Q. pungens* Liebm.

Quercus undulata var. *grisea* Engelm.‖ is *Quercus grisea* Liebm.

Quercus undulata var. *oblongata* Engelm.,¶ is *Q. oblongifolia* Torr.

Quercus turbinella Greene.** Sargent refers this species partly to *Q. undulata* and partly to *Q. dumosa*. As far as I can judge, Professor Greene had only one species in his description, and this is well drawn, as is also his plate 28. Professor Wooton, of the Agricultural College, New Mexico, has penciled his views on the sheets in the Columbia herbarium ; these are of great value as Professor Wooton has spent many years in the field in New Mexico and Arizona. He thinks that it is a good species and identical

* Prod. 16^2 : 23. 1864.

† Syn. Fl. Col. 127. 1874.

‡ Trans. St. Louis Acad. 3 : 382. 1876.

§ L. c., page 392.

‖ L. c., page 393.

¶ Wheeler's Rep. 6 : 250. 1878.

** West American Oaks, 1 : 37. 1889.

with *Q. berberidifolia* Liebm. In the latter supposition he was led astray by Alphonse DeCandolle, who cites Wright's no. 1868 as belonging to that species. DeCandolle had not seen the type of Liebman's *Q. berberidifolia*, which was collected by Thomas Coulter; he had seen a specimen collected by Fremont, but if this was the one mentioned by Liebman or not, is impossible to say; DeCandolle himself saw the discrepancies, and points out the differences between Liebman's description and Wright's specimens. *Q. turbinella* is evidently the same as *Q. berberidifolia* A. DC., in part; but scarcely as that of Liebman. *Q. turbinella* is related to *Q. pungens*, differing in the small, flat, thicker leaves, fulvous when young, in age only sparingly stellate-puberulent beneath; they are spiny-toothed as in *Q. pungens* but only 1–3 cm. long. The fruit is also different; the cup is very shallow, somewhat turbinate or depressed-hemispherical, about 8 mm. in diameter; the acorn is much elongated for its size, 15–20 mm. long and tapering at the apex. The only figures in Sargent's Silva that can be referred to this species are that of a fruit, viz., Pl. 393, Fig. 8, and the leaves on Pl. 385, Fig. 10–12.

Sargent's *Q. undulata* contains therefore seven species all as distinct as his own *Q. Arizonica* and *Q. Toumeyi* and several much easier to distinguish, for *Q. Arizonica* as far as leaf-form is concerned grades into *Q. reticulata* on one hand and *Q. grisea* on the other, and *Q. Toumeyi* is hard to separate from *Q. dumosa*.

The remaining species of the region, viz., *Q. oblongifolia*, *Q. Arizonica*, *Q. reticulata*, *Q. Toumeyi*, *Q. Emoryi*, *Q. hypoleuca* and *Q. chrysolepis* have been treated much better. I think, however, that the varieties under the latter are distinct species and that the Arizona-New Mexico plant is distinct from those of California.

Professor Greene's treatment of the oaks was in my opinion much more logical, notwithstanding the fact that at the time the West American Oaks was written the western oaks were much less known than now and perhaps not one-fourth the

number of specimens were accessible. He followed DeCandolle in the interpretation of *Q. Gambelii* and both his own specimens from the Pinos Altos Mountains and Dr. Kellogg's figure represent *Q. Gambelii* Liebman, not Nutt.; that is also the reason for his describing it as a tree in Arizona. The doubtful specimen described and figured in the second volume, Pl. 33, is an undescribed species.

Following Engelmann and Kellogg, Professor Greene adopted the name *Q. undulata* for the complex aggregate, two members of which were represented on Kellogg's Pl. 13, figs. 3 and 4; fig. 3 evidently represents *Q. Arizonica* Sargent and fig. 4 *Q. pungens* Liebm. That Professor Greene was not satisfied with this treatment is shown by the fact that he republished *Q. undulata* with a figure that evidently represents a specimen of that species, but with deeper lobed leaves than in the typical form.

Later on in Pittonia **2**: 112–114, Dec., 1890, he clearly shows the relationship between *Q. pungens*, *Q. undulata*, *Q. turbinella*, *Q. berberidifolia*, *Q. dumosa*, *Q. agrifolia* and *Q. chrysolepis;* I came to exactly the same results independently, before I had looked up this reference.

Greene's *Q. undulata* var. *grisea*, includes besides *Q. grisea* Liebman, *Q. Arizonica* Sargent and *Q. oblongifolia* Torr. He had at that time a somewhat broader conception of a species than now, and besides, the three species are so closely related that most conservative botanists would regard them as one.

The other species from the region described by Greene, viz.: *Q. Fendleri* Liebm., *Q. Emoryi* Torr., *Q. hypoleuca* Engelm., together with Greene's own *Q. venustula* and *Q. turbinella* are well treated.

A few words may be said regarding the only manuals covering the region, viz.: Coulter's Manual of the Rocky Mountain Region and his Manual of Texas. In the former Professor Coulter follows Engelmann's treatment, with many varieties under *Q. undulata*. Engelmann's variety *grandifolia* I have been unable to identify; it was not in the collec-

tion borrowed from the Missouri Botanical Garden. In his Texas Manual, Professor Coulter places both *Q. undulata* and *Q. Gambelii* under the LIVE OAKS, stating, however, that they have deciduous leaves; it is most surprising, however, that he placed *Gunnisonii* as a variety of *Q. undulata* and not of *Q. Gambelii;* he evidently did not take time to give a personal investigation to the matter.

KEY TO THE SPECIES.

* Acorns not sericeous-tomentose inside, annual (except perhaps in No. 27).
† Leaves lobed or divided, not evergreen; lobes rounded, obtuse or acute, but not spinulose-tipped.
Leaves bright green, early deciduous.
Upper scales of the cup with caudate prolongations.
1. *Q. macrocarpa.*
Upper scales of the cup not prolonged.
Mature leaves softly pubescent, almost velvety beneath, deeply divided.
Scales of the cup thin, not much thickened on the back. 2. *Q. submollis.*
Scales of the cup corky-thickened on the back.
3. *Q. Utahensis.*
Mature leaves glabrate, puberulent or somewhat pubescent but not velvety beneath.
Cup flat, covering less than one-fourth of the acorn.
4. *Q. Vreelandii.*
Cup hemispheric, covering one-third to one-half of the acorn.
Acorns barrel-shaped, obtuse.
Mature leaves very thin, glabrate beneath or puberulent only on the veins; cup covering about one-half of the acorn.
5. *Q. leptophylla.*
Mature leaves firm, puberulent beneath; cup covering about one-third of the acorn.
Leaves mostly oblong in outline, lobed half way to the midrib or less, rather dull.
6. *Q. Gunnisonii.*
Leaves obovate in outline, divided deeper than half way to the midrib, very shining above.
Lobes of the leaves broadly oblong, rounded at the apex.
7. *Q. nitescens.*
Lobes of the leaves ovate or triangular, acute.
8. *Q. Novo-Mexicana.*

Acorns ovoid, acute; cup covering about one-half of the acorn. 9. *Q. Gambelii.*

Leaves pale or bluish green, more persistent.

Leaves broadly obovate with narrow sinuses. 10. *Q. Eastwoodiae.*

Leaves oblong-obovate, or elliptic; sinuses broad.

Lobes oblong-ovate, obtuse or acutish, not mucronate. 11. *Q. venustula.*

Lobes triangular-ovate, mucronate.

Cup 10–15 mm. in diameter; acorn yellowish, ovoid. 12. *Q. Fendleri.*

Cup 18–25 mm. in diameter; acorn dark brown, spherical-ellipsoid. 13. *Q. Havardii.*

†† Leaves persistent, usually evergreen, entire, sinuate or dentate; or if deeper lobed with spinulose tips.

Leaves broadly obovate, undulate round-lobed.

Leaves thick and reticulate, brownish stellate-pubescent beneath. 14. *Q. obtusifolia.*

Leaves thin, less reticulate, almost silvery-puberulent beneath. 15. *Q. breviloba.*

Leaves not broadly obovate (except in *Q. reticulata*); lobes, if any, acute, mucronate or spinulose-tipped.

Scales of the cup decidedly corky-thickened on the back.

All the leaves sinuately lobed or dentate all around.

Leaves usually more than 5 cm. long, broadly oval or ovate, 5–7-lobed; cup 12–18 mm. broad. 16. *Q. pauciloba.*

Leaves usually less than 5 cm. long, oblong or oval-oblong; cup 8–10 mm. broad.

Leaves not fulvous.

Leaves decidedly crisped, sinuately lobed; lobes distinctly spinulose-tipped. 17. *Q. pungens.*

Leaves flat, sinuately dentate; teeth mucronate or slightly spinulose-tipped. 18. *Q. undulata.*

Leaves more or less fulvous beneath especially when young. 26. *Q. turbinella.*

Leaves mostly entire or undulate, or dentate above the middle.

Leaves permanently densely stellate-pubescent beneath.

Leaves oblong, usually less than 6 cm. long.

Leaves not strongly reticulate beneath.

Pubescence light gray, not fulvous. 19. *Q. Mohriana.*

Pubescence more or less fulvous.

Cup hemispheric; acorns barrel-shaped. 20. *Q. grisea.*

Cup more or less turbinate; acorns elongated ovoid.
26. *Q. turbinella.*

Leaves strongly reticulate beneath.
21. *Q. Arizonica.*

Leaves broadly obovate, usually over 6 cm. long.
22. *Q. reticulata.*

Leaves in age glabrous beneath.
23. *Q. oblongifolia.*

Scales of the cup thin, only slightly thickened on the back.

Leaves not fulvous.

Leaves ovate or lanceolate, in age glabrous, obscurely reticulate-venulose. 24. *Q. Emoryi.*

Leaves oval, oblong or ovate-oblong, puberulent beneath, decidedly reticulate-venulose.
25. *Q. Toumeyi.*

Leaves more or less fulvous, especially when young.

Leaves oblong to oval or ovate, usually sinuate spinulose-dentate, strongly reticulate beneath; cup more or less turbinate. 26. *Q. turbinella.*

Leaves, except those of the young shoots, broadly oval or ovate, subentire, abruptly acuminate, not strongly reticulate; cup hemispheric. 27. *Q. Wilcoxii.*

** Acorns sericeous-tomentose inside, biennial.

Leaves lanceolate, long-attenuate, entire or merely toothed, white-tomentose beneath. 28. *Q. hypoleuca.*

Leaves pinnately lobed with spinose-tipped triangular lobes, green and glabrous on both sides or pubescent on the veins beneath.
29. *Q. Texana.*

1. QUERCUS MACROCARPA Michx. Hist. Chênes Am. No. 2. 1801.

This well-known oak does not reach the Rockies as far as I know. Professor Sargent claims that it is found in the "eastern foothills of the Rocky Mountains of Montana." I have spent three summers in that region, and Mr. R. S. Williams half his life in the State, but neither he nor I have found any oaks there. It is found in the Black Hills of South Dakota and Wyoming, but that is to my knowledge as far west as it extends. Its range seems to be from Nova Scotia to Lake Winnipeg, eastern Assiniboia, Black Hills, Central Texas, Tennessee and Pennsylvania. In the Black Hills and western Nebraska, it fruits at a height of two meters.

2. Quercus submollis sp. nov.

Size of the tree unknown. Bark of young branches light brown, roughened with numerous lenticels, finely pubescent; that of the older branches light ashy gray, sometimes almost white and shining: petioles about 1 cm. long, densely pubescent with brownish hairs: leaf-blades narrowly obovate in outline, deeply pinnately lobed with the rounded sinuses extending two-thirds to the midrib: segments rounded, rarely lobed; upper surface green, sparingly stellate, or glabrous and shining in age; lower surface brownish, pale, densely and softly pubescent, veins rather prominent: bud-scales light brown, thin and pubescent: fruit sessile: cup depressed-hemispheric, about 15 mm. in diameter; scales oblong, rather thin, scarcely at all thickened on the back, puberulent; acorn short barrel-shaped, obtuse, 12–15 mm. long, light brown.

This species is closely related to the next following and hard to distinguish without the fruit. This is quite different; the scales lack the corky thickening common in this group of oaks and this character together with the dense and soft pubescence of the lower surfaces of the leaves, easily distinguish it from *Q. Gambelii.*

ARIZONA: 1894, *T. E. Wilcox*, *191a*, in part (type in U. S. Nat. Herb.), *191* and *155* (*l*)*; Huachuca Mountains, 1894, *J. W. Toumey;* Chiricahua Mountains, 1894, *J. W. Toumey* (*l*); 1869, *Dr. E. Palmer* (*fl*)†; Flagstaff, 1898, *D. T. MacDougal, 39* (*fl*); Fort Huachuca, 1892, *T. E. Wilcox* (*l*); Bill Williams Mts., 1865, *E. Palmer* (*l*); Santa Magdalena Mountains, 1881, *Vasey* (*l*).

ILLUSTRATIONS: *Pl. 25. f. 1.*

3. Quercus Utahensis (A. DC.).

(?) *Quercus Gambelii* Torr. Sitgreaves' Rep. 172. 1854.

Quercus Gambelii Liebm. Oversigt Dansk. Vidensk. Selsk. Forh. 1854: 169; not Nutt.; also Sarg. Silva N. A. **8**: 33, in part. 1895.

Quercus stellata δ Utahensis A. DC. Prod. 16[2]: 22. 1864.

* Specimens followed by an (*l*) are in mature leaves without fruit and therefore doubtful.

† Specimens followed by (*fl*) are in flowers only and therefore somewhat doubtful.

Quercus Douglasii β ? Gambelii A. DC. Prod. **16**^{2}: 23, in part. 1864.

Quercus alba var. *Gunnisonii* Wats. King's Rep. **5**: 321, in part. 1871.

A small tree, often 10 m. high or more or sometimes only a shrub. Bark of young branches light brown and pubescent, less roughened than in the preceding; bark of the older branches brown or gray, but not as light and shining as in *Q. submollis*; bark of the trunk rough and furrowed: bud-scales thin, brown, somewhat hairy and puberulent: petioles about 1 cm. long, puberulent: leaf-blade 6–10 cm. long, broadly obovate, deeply divided, often to near the midrib; lobes oblong, rounded at the apex, the larger usually again lobed or undulate; upper surface sparingly stellate, in age glabrate, dark green and glossy; lower surface brownish, pale, densely and softly pubescent, almost velvety, strongly veined: fruit subsessile: cup hemispheric, 12–15 mm. in diameter; scales pubescent, ovate, with much thickened corky backs; acorn ovoid, barrel-shaped, mostly obtuse, 15–20 mm. long, light brown.

This species closely resembles the preceding as stated above. The leaves are as a rule deeper divided and resemble therefore more those of *Q. nitescens*, from which this species differs mainly in the larger size of the tree and the dense pubescence of the lower surface of the leaves. It grows in mountain regions of Utah, Colorado, Arizona and New Mexico. The following specimens belong here:

UTAH: Salt Lake City, 1880, *Geo. Engelmann;* Bear River Valley, 1843, *Fremont, 749;* Filmore Cañon, 1872, *H. C. Yarrow;* Lake Camp, 1845, *Fremont, 311 (l);* Spanish Fork of Uintah, 1844, *Fremont, 506 (fl);* Wahsatch Mountains, 1869, *S. Watson, 1086*, in part; Spring Lake, 1875, *C. C. Parry*.

ARIZONA: Grand Cañon of the Colorado, 1897, *T. F. Allen* (*l*); Pagumpa, 1894, *M. E. Jones, 5094* (*fl*); Camp Apache, 1873, *G. K. Gilbert* (*fl*); Santa Rita Mountains, 1881, *C. G. Pringle*, *7* and *10**, also *12* (*fl*); southern Ari-

* Pringle's specimens are in flower, the leaves are longer, narrower and less deeply lobed than usual, 10–18 cm. long, and may belong to a distinct species. They have the soft pubescence of this species, however.

zona, 1881, *C. G. Pringle;* San Francisco Mountains, 1851, *Sitgreaves' Expedition;* Dos Cabozes, 1871, *J. G. Lemmon, 311 (l);* Willow Spring, 1874, *Rothrock, 252;* 1870, *E. Palmer;* Grand Cañon, 1892, *E. O. Wooton.*

NEW MEXICO: Pinos Altos Mountains, 1880, *E. L. Greene;* White Mountains, 1897, *E. O. Wooton, 367;* Santa Magdalena Mountains, 1881, *G. R. Vasey (fl);* Santa Fe, 1847, *Fendler, 806 (fl).*

COLORADO: Manitou, 1891, *Wm. Trelease (l);* North Cheyenne Cañon, 1886, *E. A. Bessey;* Hotchkiss, 1892, *J. H. Cowen;* Mancos, 1895, *Alice Eastwood.*

TEXAS: Guadalupe Mountains, 1881, *V. Havard.*

ILLUSTRATIONS: *Pl. 25. f. 2;* Sitgreaves' Rep. *plate 18 (?);* Oerst. Liebman, Chenes Am. Trop. *pl. 40. f. 1;* Greene, West Am. Oaks, *pl. 13. f. 1–2;* Sargent, Silva, *pl. 367. f. 4–5 (?).*

4. **Quercus Vreelandii** sp. nov.

Quercus Gambelii Sargent, Silva N. Am. **8**: 331, in part. 1895.

A small shrub, 1–1.5 m. high. Bark of young branches brown, puberulent; that of the older branches and trunks ashy gray: bud-scales brown, thin, puberulent on the margins: petioles 5–10 cm. long, puberulent: leaf-blades 5–7 cm. long, obovate, deeply lobed about two-thirds to the midrib, thick, firm; lobes rounded, the larger often lobed or sinuate; upper surface slightly stellate, soon glabrate, bright green and rather dull; lower surface slightly paler and somewhat brownish and puberulent: fruit subsessile: cup very shallow, covering one-fifth or one-sixth of the acorn; scales ovate and very corky on the back: acorn barrel-shaped or slightly ovoid, obtuse, about 15 mm. long, light brown.

In leaves this species most resembles *Q. Gambelii;* the upper surface is, however, brighter green, and the leaf is much firmer and therefore more like that of *Q. Gunnisonii* in texture. It is more obovate in outline than in that species, the fruit is smaller and the cup is very shallow; in the latter respect it differs from all the related species. It is also a smaller and more scraggling bush. The leaves are light

yellow when unfolding, turning pinkish yellow in age. It grows on hillsides at an altitude of about 2500 m.

COLORADO: Mesas near La Veta, 1900, *F. K. Vreeland, 685* (type); Butte, five miles southwest of La Veta, *Rydberg & Vreeland, 6350* (*l, fl*), *6349* (*l, fl*).

NEW MEXICO: 1847, *A. Fendler, 810b*, in part.

ILLUSTRATIONS: *Pl. 25, f. 3;* Sargent, Silva, *pl. 367. f. 1.*

A peculiar form with smaller, more glossy and more oblong leaves 5–6 cm. long, and smaller fruit with cup only 8–10 mm. wide and covering about one-third of the more acute acorn I refer doubtfully to this species. It is represented by the following specimens:

NEW MEXICO: Chama, 1899, *C. F. Baker, 280.*

COLORADO: Trinidad, 1892, *C. S. Crandall* (*l*).

4. **Quercus leptophylla** sp. nov.

Quercus Gambelii Sargent, Silva N. Am. 8: 33, in part. 1895.

A tree 10–15 m. high. Bark of young twigs brownish or purplish, slightly pubescent at first; that of the older branches gray; that of the trunk rough and furrowed: bud scales very thin, brown, glabrous: petioles about 1.5 cm. long, sparingly stellate: leaf-blades broadly obovate, very thin, pinnately 5–9-lobed scarcely more than half way to the midrib; lobes rounded; upper surface at first sparingly stellate, soon glabrate, bright green, but not very glossy; lower surface paler, almost perfectly glabrous, or pubescent on the veins: fruit subsessile: cup hemspheric, about 15 mm. wide, covering about half the acorn; scales ovate-lanceolate, obtuse, only slightly thickened on the back; acorns short barrel-shaped, obtuse or even depressed at the apex.

This species has a cup that most resembles that of *Q. submollis* but the scales are slightly more thickened. These two are the only White Oaks of the region that do not have thick, corky scales. *Q. leptophylla* is easily distinguished from *Q. submollis* and the other oaks of the region by the thin, almost glabrous leaves; in Colorado it is the only species that reaches the size of a large tree, as far as I know. All the scrub-oaks of the State grow on the open mesas or the

hillsides; this is only found along streams, especially in the cañons. I have seen specimens with trunks over 2 m. in circumference and 15 m. high. In general habit and its vigorous growth it is so unlike the other oaks of the region, that I can not see why it has been included in *Q. Gambelii.* It grows at an altitude of 1800–2700 m.

COLORADO: Tributaries of Turkey Creek, *Rydberg & Vreeland, 6347* (type); North Cheyenne Cañon, 1896, *E. A. Bessey;* Routt Co., 1894, and Manitou, 1892, *C. S. Crandall* (*fl*); Table Rock, 1891, *Crandall, 465* (*l*); Chicken Creek, 1898, *Baker, Earle & Tracy, 803* (*l*).

ILLUSTRATIONS: *Pl. 26, fig. 1–2.*

6. Quercus Gunnisonii (Torr.).

Quercus alba β (?) *Gunnisonii* Torr. Pac. R. R. Rep. **2**[1]: 130. 1855.

Quercus undulata β Gunnisonii Engelm. Trans. St. Louis Acad. **3**: 382. 1876.

Quercus Gambelii var. *Gunnisonii* Wenzig, Jahrb. Bot. Gar. Berlin **3**: 190. 1885.

A low shrub* 1–3 m. high. Bark of young branches light brown, puberulent, of the older branches and the trunk gray, somewhat shreddy: bud-scales brown, pubescent: petioles about 1 cm. long, puberulent: leaf-blades oblong, elliptic or narrowly obovate in outline, lobed to about half way to the midrib, with rounded lobes generally directed forward, very thick, somewhat pale and bluish green above, sparingly stellate or soon glabrate, not very shiny; lower surface scarcely paler but brownish, puberulent, strongly veined: fruit subsessile: cup rather deep, 12–15 mm. in diameter, hemispherical, covering about one-third of the acorn; scales ovate with a lanceolate tip, at least the lower much thickened and corky on the back; acorns barrel-shaped, obtuse or even depressed at the apex.

This species differs from *Q. Gambelii* in the obtuse acorn, and in the narrower and firmer leaves, which are not much

*This as well as several other species are here described as shrubs. The individuals have, however, often single trunks. A great number grow generally together and form a large thicket of individuals of the same height; a thicket of one species is easily distinguished from that of another even at a distance by the different color of the leaves.

paler beneath than above. It is generally a much lower shrub. The leaves are light colored, somewhat yellowish, when they unfold. It grows on dry hillsides and mesas at an altitude of 2000–2500 m.

COLORADO: Cochelopa Pass, *Gunnison Expedition, 47* (type in Columbia herbarium); La Veta, 1900, *F. K. Vreeland, 678;* Cucharas Valley, *695;* North Cheyenne Cañon, 1896, *E. A. Bessey* (*l*); Colorado Springs, 1872, *Torrey;* Cañon of the Arkansas, 1874, *G. Engelmann, 5;* Colorado City, 1871, *W. M. Canby;* Cañon City, 1874, *T. S. Brandegee.*

NEW MEXICO: Mogollon Mountains, 1881, *H. H. Rusby, 384.*

ARIZONA: Grand Cañon, 1894, *J. W. Toumey;* Flagstaff, 1889, *Munson & Hopkins* (*fl*).

UTAH: Echo, 1895, *Rydberg;* Cottonwood Cañon, 1869, *S. Watson, 1086,* in part; City Creek Cañon, 1888, *M. E. Jones, 1722.*

ILLUSTRATIONS: *Pl. 26. fig. 3.*

7. **Quercus nitescens** sp. nov.

Quercus Gambelii (?) Greene, West Am. Oaks, **2**: 71. 1890; Sargent, Silva N. Am. **8**: 33, in part. 1895.

Quercus alba var. *Gunnisonii* Port. & Coult. Syn. Fl. Colo. 127, in part. 1874.

A shrub 3–5 m. high. Bark of the stems gray and flaky, that of the branches light brown; young branches puberulent: bud-scales light brown, pubescent: petioles 1–1.5 cm. long, puberulent: blades broadly obovate in outline, deeply divided at least three-fourths to the midrib or sometimes almost to it, very firm, red and somewhat stellate puberulent when unfolding in the spring; upper surface in age dark green and very shining; lower surface paler and puberulent; lobes spreading, broadly oblong, entire or sinuately lobed, usually rounded at the apex: fruit subsessile: cup hemispherical, 10–15 mm. wide, covering about one-third of the acorn; scales ovate and much corky-thickened on the back; acorns 15–18 mm. long, barrel-shaped, mostly obtuse.

This is the most common oak of the group, especially in

Colorado, where it grows on mesas and hillsides at an altitude of 2000–2500 m. It is closely related to *Q. Novo-Mexicana*, differing in the obtuse or rounded lobes of the leaves. As I have seen no mature fruit of *Q. Novo-Mexicana*, I can not tell if there is any difference in the acorns. There is some indication that the acorn of the latter is shorter than in this species. *Q. nitescens* differs from *Q. Gunnisonii* and *Q. Gambelii* in the more glossy and deeper lobed leaves and has generally comparatively longer acorns than the former and thicker than the latter. It was figured by Greene in his West American Oaks **2**: *pl. 33*, and referred by him doubtfully to *Q. Gambelii*.

COLORADO: Mesas near La Veta, 1900, *F. K. Vreeland*, *677* (type) and *676*; Colorado Springs, 1873, *T. C. Porter;* Morrison, 1889, *E. L. Greene;* Ruxton, 1900, *Fred Clements* (*l*); Cucharas River, above La Veta, 1900, *Rydberg & Vreeland*, *6352* (*fl*), *6355* (*fl*); North Cheyenne Cañon, 1896, *E. A. Bessey* (*l*); Glenwood, 1897, *Mrs. Wislizenus* (*l*); Routt Co., 1896, *C. F. Baker* (*l*); Manitou, 1891, *Wm. Trelease;* Colorado City, 1871, *W. M. Canby;* West Mancos Cañon, 1898, *Baker, Earle & Tracy*, *391* (*l*); Ute Pass, 1895, *Mrs. S. L. Clarke;* Arkansas, 1845, *Fremont*, *52;* Colorado Springs, 1872, *John H. Redfield*, *563;* Bear Creek Cañon, 1889, *E. L. Greene;* Manitou and Arkansas Cañon, 1874, *Geo. Engelmann.*

UTAH: Ogden, 1871, *T. C. Porter* (*fl*); Spring Lake, 1875, *C. C. Parry.*

ILLUSTRATIONS: *Pl. 27. fig. 1.* Greene, West Am. Oaks, *pl. 33;* Sargent, Silva N. Am. *pl. 366.*

8. **Quercus Novo-Mexicana** (A. DC.).

Quercus Douglasii γ Novomexicana A. DC. Prod. **16**[2]: 24. 1864.

Quercus alba var. *Gunnisonii* Wats. King's Rep. **5**: 321, in part, 1871; Port. & Coult. Syn. Fl. Colo. 127, in part. 1874.

A shrub 3–5 m. high. Bark of young branches light brown, or grayish, sparingly puberulent or glabrous; that of

the older branches and trunks light gray; that of the latter rough, furrowed and flaky: bud-scales brown, puberulent: petioles about 1 cm. long, often tinged with red, puberulent: leaf-blades obovate in outline, deeply divided about three-fourths the distance to the midrib, very firm, red when unfolding in the spring; upper lobes mostly ovate, acute, often lobed or undulate, the lower broadly triangular; upper surface at first sparingly stellate, soon glabrous, dark green and very glossy; lower surface pale green, puberulent, rather strongly veined: fruit subsessile: cup hemispheric, 10–12 mm. in diameter; scales ovate and moderately corky-thickened on the back; acorn light brown, mostly obtuse.

This species is characterized by its deeply dissected, very glossy leaves, which are bright red when they unfold. The size of the cup is that of *Q. Gambelii*, but the acorn is obtuse and the leaves are deeper cleft, darker green and more glossy above. I have not seen mature acorns of this species. It grows on mesas and hillsides at an altitude of 2000–2500 m.

New Mexico: Santa Fe, 1847, *Fendler*, *809* (*fl*, *l*, *type*), *810b* (*fl*), *810* (*l*); 4 miles east of Santa Fe, 1897, *A. A. & Gertrude E. Heller*, *3614* (*fl*).

Colorado: Mancos, 1895, *Alice Eastwood;* Manitou, 1874, *Geo. Engelmann* (*l*); Engelmann Cañon, 1896, *E. A. Bessey* (*l*); Cheyenne Mountain, 1895, *Mrs. S. L. Clark* (*l*); Cañon City, 1873, *T. S. Brandegee* (*fl*); Cuchara River, 1900, *Rydberg & Vreeland*, *6355* (*fl*), *6356* (*fl*) and *6357* (*fl*); Rocky Mountains, Lat. 39–41°, 1862, *Hall & Harbour*, *515* in part.

Utah: St. George, 1874, *C. C. Parry*, *5* (*fl*); American Cañon, *S. Watson*, *1086* in part.

Illustrations: *Pl. 27. f. 2.*

9. Quercus Gambelii Nutt. Journ. Phil. Acad. II. **1**: 179. 1848.

Quercus Douglasii β ? Gambelii A. DC. Prod. **16**^{2}: 23, in part. 1864.

Quercus undulata α Gambelii Engelmann, Trans. St. Louis Acad. **3**: 382. 1876.

A shrub 3–5 m. high. Bark of young twigs light brown and puberulent; that of the older branches and trunk gray: bud-scales brown, puberulent: petioles about 1 cm. long, puberulent: leaf-blades broadly obovate in outline, lobed one-half or two-thirds the distance to the midrib, thinner than in the preceding; upper surface glabrate, green, not very glossy; lower surface only slightly paler, puberulent or nearly glabrous; lobes rounded: fruit subsessile: cup hemispheric or somewhat turbinate; acorn ovoid, acute, half enclosed in the cup, about 15 mm. long, light brown.

The leaf form is mostly like that of *Q. Gunnisonii* but the blade is usually broader, thinner, decidedly obovate, and the acorns are much smaller and acute. From the preceding it differs in the less glossy and less deeply lobed leaves and the form of the fruit. The leaves when unfolding are pinkish yellow. It is much less common than the preceding, to which it is closely related; some intermediate forms are found, although they are rare.

COLORADO: Cucharas Valley near La Veta, 1900, *F. K. Vreeland, 694; Rydberg & Vreeland, 6353* (*fl*) and *6354* (*fl*); Manitou, 1874, *Geo. Engelmann, aa, zz;* Cañon of Arkansas River, 1874, *Engelmann, 4* and *6;* South Park, 1871, *T. S. Brandegee, 7614;* Ute Pass, 1886, *William Trelease.*

NEW MEXICO: Barranca, 1897, *A. A. & G. E. Heller, 3582* (*fl*).

UTAH: Gunnison, 1875, *L. F. Ward, 76.*

ILLUSTRATIONS: *Pl. 28. f. 1.*

10. **Quercus Eastwoodiae** sp. nov.

Quercus Gambelii Eastwood, Proc. Cal. Acad. II. **6**: 324, in part. 1896.

Shrub not forming thickets. Bark of the stem and branches light brownish or gray, furrowed, that of the young branchlets densely stellate-pubescent, almost velvety: bud-scales light brown, pubescent: petioles 1–2 cm. long, pubescent: leaf-blades broadly obovate in outline, rounded at the apex, obtuse or acutish at the base, 6–8 cm. long, 3–6 cm. broad, pale bluish green; on the upper surface slightly stellate, especially on the veins, or glabrate; on the lower paler, strongly

reticulate and decidedly stellate, lobed about half way to the midrib with narrow sinuses and broad rounded lobes: fruit subsessile: cup hemispherical, 12–14 mm. in diameter; scales ovate, acutish, moderately corky-thickened on the back; acorn round-ellipsoid, mostly half included in the cup.

This species is perhaps nearest related to *Q. obtusifolia*, but the lobing of the leaves is much deeper and the fruit is larger and suggests more *Q. Utahensis* and *Q. Gunnisonii*. The pubescence and the texture and persistency of the leaves seem to be more like those of *Q. Fendleri* with which I have, therefore, associated it. It grows as a shrub 2–3 m. high in cañons of southern Utah.

UTAH: Butler Wash, 1895, *Alice Eastwood, 141.*

ILLUSTRATIONS: *Pl. 28. f. 2.*

11. QUERCUS VENUSTULA Greene, West Am. Oaks, **2**: 69. 1890.

Quercus undulata Sarg. Silva N. Am. **8**: 75, in part. 1895.

A small shrub 1–2 m. high. Bark of young twigs brown, dotted with lenticels and puberulent or glabrate, that of the older branches and stems light brown: bud-scales brown, almost glabrous: petioles about 5 mm. long, puberulent: leaf-blades 3–6 cm. long, oblanceolate or elliptic in outline, lobed more than half way to the midrib, firm; lobes oblong, acutish or obtuse, directed forward; upper surface pale bluish green, sparingly stellate, glabrate and glossy; lower surface paler, densely stellate puberulent, light brownish, very veiny and reticulate: fruits on peduncled spikes; mature acorns not seen; scales of the cup ovate, corky-thickened on the back.

This species is nearest related to *Q. Fendleri*. Its leaves have the same texture, color and pubescence, but the lobes are directed forward and of a different shape. I have seen no specimens, except those of the type collection, that can be referred here with certainty. Those collected by Havard and cited below come nearest, but in these the lobes are shorter and rounder.

COLORADO: Trinidad, 1889, *E. L. Greene.*

TEXAS: Champion Creek, 1881, *Dr. V. Havard* (?).

Illustrations: *Pl. 28. f. 3;* Greene, West Am. Oaks, *pl. 32;* Sargent, Silva N. Am. *pl. 385. f. 14.*

12. Quercus Fendleri Liebm. Oversigt Dansk. Vidensk. Selsk. Forhandl. 1854: 170.

Quercus undulata A. DC. Prod. **16^2**: 23, in part. 1864. Sargent, Silva N. Am. **8**: 75, in part. 1895.

Quercus undulata γ pedunculata A. DC. Prod. **16^2**: 23. 1864.

A shrub 1–3 m. high, scarcely forming thickets. Bark of young branches brown, puberulent; that of the older branches and trunks gray: bud-scales brownish, puberulent: petioles 3–6 mm. long, puberulent: leaf-blades oval or elliptic in outline, lobed about half way to the midrib, firm, 3–7 cm. long; lobes obliquely triangular, acute, mucronate but not spinulose tipped; upper surface sparingly stellate or glabrate, pale bluish green and shining; lower surface light brownish, stellate-puberulent, strongly veined and reticulate: fruits 2–3 together on a peduncle: cup hemispheric, covering about one-third of the acorn, 10–12 mm. broad; scales ovate and much corky-thickened on the back: acorn barrel-shaped, obtuse, or somewhat ovoid and acute, 15–18 mm. long, light brown.

Q. Fendleri is of about the same size as most of the species of the *Q. Gambelii* group but I have not found it forming any thickets. It is more scraggly. The leaves remain longer on the shrub, but are not remaining till next spring. They are much paler and resemble those of *Q. undulata* in texture but are much deeper lobed. It grows on barren hills at an altitude of 1000–2500 m.

New Mexico: Santa Fe, 1853, *A. Fendler, 805* (*l*), *808* (*l*); Albuquerque, Sandia Mts., 1884, *M. E. Jones, 4159;* Santa Fe, 187, *Wheeler Expedition, 57.*

Colorado: McElmo Creek, 1895, *Alice Eastwood, 143;* Cañon of the Arkansas, 1874, *Geo. Engelmann;* Green Horn Mountains, 1874, *T. S. Brandegee* (*l*); Trinidad, 1889, *E. L. Greene;* Panchio Pass, 1873, *John Wolfe, 818.*

Kansas (?): *Fremont.*

Texas: Canadian River, 1853–4, *Bigelow.*

Arizona: 1874, *Rothrock, 57.*

Illustrations : *Pl. 29. f. 1;* Oersted, Liebm. Chênes Am. Trop. *pl. 40. f. 2;* Greene, West. Am. Oaks, *pl. 31;* Sargent, Silva N. Am. *pl. 385. f. 6–8.*

13. Quercus Havardi sp. nov.

A shrub often less than 1 m. high. Bark of young branches brown, pubescent, with scattered lenticels; that of the older stems and branches dark brownish gray: bud-scales grayish brown, pubescent: petioles short, 4–7 mm. long: leaf-blades elliptic, oblong-oval or narrowly oblong-obovate in outline, lobed half way to the midrib, thick and firm, pale bluish green, shining and slightly stellate above, pale yellowish or brownish, densely stellate and somewhat ferruginous beneath, rather strongly reticulate; lobes obliquely triangular, acute, mucronate but not spinulose-tipped: fruit subsessile: cup hemispheric, 18–25 mm. in diameter; outer scales ovate and much corky-thickened on the back, the inner lanceolate and less thickened; acorn spherical-ellipsoid, dark brown, shining, 16–20 mm. broad and 2–2.5 cm. long.

This species closely resembles *Q. Fendleri* in every respect except the fruit, which is larger than in any other member of the group and dark brown instead of yellowish. An acorn of this species was collected by Dr. James and mixed in with the type of *Q. undulata.* Dr. Torrey figures it with that species, but seems to have doubted its belonging there from the beginning; his notes to that effect are on the type sheet. As *Q. undulata* and *Q. Havardi* have the same habit and the leaves of the latter have almost the same structure and form, although deeper lobed, it is not strange that James confused them. *Q. Havardi* grows on sandhills of the Staked Plains. The large acorns are good to eat.

Texas: Sandhills of the Staked Plains, *Dr. V. Havard, 51* (type in Mo. Bot. Gard.); Camp near the Canadian River, 1853, *Bigelow* (Whipple Exp.); *James* (Long's Exp., fruit only).

Illustrations: *Pl. 29. f. 2;* Torr. Ann. Lyc. N. Y. *pl. 4* (fruit only).

14. Quercus obtusifolia (A. DC.).

Quercus undulata β obtusifolia A. DC. Prod. 16^2: 23. 1864.

Quercus undulata Sargent, Silva N. Am. **8**: 75, in part. 1895.

A shrub 2–4 m. high. Bark of the stems gray, that of the young branches brownish and pubescent: bud-scales brown, hairy when young: petioles short, 5–10 mm. long: leaf-blades broadly obovate in outline, rounded at the apex, obtuse or rounded at the base, sinuately round-lobed, very firm, 3–7 cm. long; those of the young shoots more elongated and deeper lobed; upper surface pale bluish green, shining, when young sparingly stellate-puberulent; lower surface pale, brownish, densely stellate and somewhat ferruginous: cup 15–18 mm. in diameter, hemispheric; acorn ellipsoid, dark brown, about 1.5 cm. broad and 2 cm. long.

The leaves of this species most resemble those of *Q. breviloba* but are broader, and with a different texture and pubescence, which are like those of the leaves of *Q. Fendleri* and *Q. Havardi*. The cup is that of *Q. Fendleri*, but larger and the acorns resemble those of *Q. Havardi* but are somewhat smaller. Alphonse DeCandolle made it a variety of *Q. undulata* but we must remember that his *Q. undulata* was not that of Torrey, but is *Q. Fendleri* Liebm. *Q. obtusifolia* grows on hills and mountains of Texas, New Mexico and Arizona.

New Mexico: Mountains about Santa Fe, 1847, *Fendler*, *807* (type); *Wright*, *666* (in part).

Texas: Sandhills of the Staked Plains, 1881, *Dr. V. Havard*, *52* (in part).

Arizona: 1869, *Dr. E. Palmer*.

Illustrations: *Pl. 29. f. 3–4;* Sargent, Silva N. Am. *pl. 385, f. 13*.

15. Quercus breviloba (Torr.) Sarg. Gard. & For. **8**: 93. 1895.

Quercus obtusifolia var. ? *breviloba* Torr. Bot. Mex. Bound. Surv. 206. 1859.

Quercus San Sabeana Buckley; Young Fl. Texas, 507. 1873.

Quercus Durandii var. *San Sabea* Buckl. Bull. Torr. Club, **10**: 91. 1883.

A shrub or small tree forming thickets. Bark light gray, that of the trunks scaly, that of the young branches puberulent: bud-scales dark brown and glabrous or puberulent: petioles very short: blades obovate, 3–6 cm. long, obtuse at the apex, acute at the base, rather thin, sinuately round-lobed, sometimes entire or 3-lobed at the apex; upper surface pale bluish green and shining; lower surface pale and somewhat silvery, finely stellate-puberulent: cup shallow, 12–14 mm. broad and about 6 mm. deep, covering one-fourth to one-third of the acorn; scales ovate, somewhat thickened on the back; acorn barrel-shaped, about 1.5 cm. long and 1 cm. in diameter.

The description given above is that of the form occurring in western Texas. The large tree of eastern Texas and the lower Mississippi Valley, *Quercus Durandii* of Buckley, is also included in this species by Sargent. I do not think that the two can be regarded as one species; they were regarded as distinct by Buckley and by Young. As represented in the Columbia herbarium *Q. Durandii* has narrower, more entire leaves, which are thinner and more silvery beneath; the cup is much flatter, scarcely 4 mm. deep. The Columbia herbarium has the following specimens of *Q. breviloba*.

TEXAS: Howard's Spring, *Bigelow* (Mex. Bound. Surv., type); Austin, 1883, *S. B. Buckley;* Dallas, *Reverchon* (Curtiss' no. 2779*); Sutherland Spring, 25 miles southeast of San Antonio, 1879, *E. Palmer* (oblanceolate leaves); Austin, 1881, *J. H. Redfield.*

ILLUSTRATIONS: *Pl. 30. f. 1–2;* Sargent, Silva N. Am. *pl. 384.*

16. **Quercus pauciloba** sp. nov.

A tree about 4–5 m. high. Bark of the older branches light gray, that of the young twigs light brownish, pubescent: petioles .5–1 cm. long: leaf-blades broadly oval, ovate or rarely obovate, 5–8 cm. long, 3–5 cm. wide, sinuately 5–7-lobed; upper surface pale bluish green, in age glabrous, rather dull; lower surface pale brownish, more or less stellate-puberulent, strongly reticulate; lobes broadly triangular, short spinulose tipped, the larger sinuate-dentate: cup hemispheric, 12–18 mm. in diameter; scales ovate, acuminate, corky on the back; acorn ellipsoid, or barrel-shaped, sometimes 15 mm. long.

A peculiar oak, related to *Q. Fendleri* and *Q. Havardi* on the one hand and *Q. pungens* on the other, but easily distinguished from the first two by the few spinulose-tipped lobes, from the latter by the larger fruit and from all three by the large broad leaves. It grows in rich soil of Central Arizona.

ARIZONA: Beaver Creek, 1891, *D. T. MacDougal* (type in U. S. Nat. Herb.).

ILLUSTRATIONS: *Pl. 30. f. 2.*

17. QUERCUS PUNGENS Liebm. Oversigt Dansk. Vidensk. Selsk. Forh. 1854: 171.

Quercus Emoryi Torr. Mex. Bound. Surv. 206, in part. 1859.

Quercus Emoryi Port. & Coult. Syn. Fl. Col. 127. 1874.

Quercus undulata δ Wrightii Engelm. Trans. St. Louis Acad. **3**: 382, in part. 1876.

Quercus undulata var. *pungens* Engelm. Trans. St. Louis Acad. **3**: 392. 1877.

Quercus undulata Greene, West Am. Oaks **1**: 27, in part. 1889; Sargent, Silva N. Am. **8**: 75, in part. 1895.

A low shrub, 1–3 m. high, rarely larger. Bark of the stem and branches gray, that of the younger twigs more yellowish or brownish, densely stellate-pubescent: bud-scales brown, slightly pubescent: petioles very short, 2–5 mm. long: leaf-blades oval or broadly oblong, obtuse at the base, acute at the apex, deeply sinuately toothed, 3–5 cm. long, thick and firm, usually decidedly undulate and twisted; upper surface pale bluish or brownish green, rather dull, sparingly, but usually permanently, stellate; lower surface more or less densely stellate, pale yellowish or brownish, sometimes strongly reticulate, especially in age; lobes triangular and usually spinulose-tipped: cup hemispherical, 8–10 mm. in diameter; scales with very prominent corky thickenings; acorns barrel-shaped, 10–13 mm. long, obtuse or acutish, light brown.

Q. pungens is nearest related to *Q. undulata* but the leaves are deeper lobed, firmer, usually decidedly undulate or crisped and more pubescent and more reticulate beneath, the

lobes more decidedly spinulose-tipped and the acorns shorter; intergrading forms are occasionally met with. The species grows on dry mesas and hills, perhaps to an altitude of 2000 m. This is an evergreen even at its northern limit. Brandegee found it in Colorado bearing old green leaves in January and April.

TEXAS: Western Texas, 1849, *C. Wright, 664* (type); Between San Pedro and Howard Springs, 1851, *Bigelow*, (Mex. Bound. Surv.); Guadalupe Mountains, 1881, *Dr. V. Havard, 66* and *67*; El Paso, 1881, *G. R. Vasey.*

COLORADO: Cañon City, 1873 and 1875, *T. S. Brandegee;* Arkansas Cañon, 1874, *Engelmann.*

UTAH: Barton's Range and Butler's Wash, San Juan Co., 1895, *Alice Eastwood, 140.*

ARIZONA: Swisshelm Mountains, 1894, *J. W. Toumey;* Santa Catalina Mountains, 1881, *J. G. Lemmon*; Skull Valley, 1865, *Coues & Palmer, 234;* Rencou Mountains, 1894, *J. W. Toumey;* 1851, *Woodhouse* (Sitgreaves Exped.).

MEXICO: Santa Eulalia Mountains, 1886, *C. G. Pringle, 849;* 1885, *172.*

ILLUSTRATIONS: *Pl. 30. f. 3;* Oersted, Liebm. Chenes Am. Trop. *pl. 45. f. 1–3;* Greene, W. Am. Oaks, *pl. 13. f. 4;* Sargent, Silva N. Am. *pl. 385. f. 5.*

18. QUERCUS UNDULATA Torr. Ann. Lyc. N. Y. **2**: 248. 1828.

Quercus undulata γ Jamesii Engelmann, Trans. St. Louis Acad. **3**: 382. 1876.

A shrub 1–3 m. high. Bark of the trunk gray, rough and much cracked, that of the branches light gray and with numerous lenticels; that of the young twigs sparingly stellate-pubescent: petioles 2–6 mm. long: leaf-blades firm, but less so than in *Q. pungens*, pale bluish or brownish green and shining above, pale brownish beneath, stellate when young, almost glabrous in age on both sides or even densely stellate pubescent beneath, only sinuately dentate, acute at both ends; teeth mucronate, scarcely spinulose: cup hemispheric, 7–10 mm. broad; scales ovate, strongly corky-thickened on the

back; acorn barrel-shaped or cylindric, 10–15 mm. long, 6–7 mm. in diameter, brown.

This species is nearest related to *Q. pungens* but differs in the flatter leaves, which are less deeply sinuate, less spinulose and less pubescent. The fruit is also generally longer and narrower. The fruit mounted on the type sheet and figured by Torrey does not belong to this species but to *Q. Havardi* (see that species). *Q. undulata* grows on barren hills up to an altitude of 2000 meters; the leaves are evidently evergreen and more persistent than in *Q. Fendleri*, with which it grows and with which it has been confused.

COLORADO: Rocky Mountains, *Dr. James* (type); Cañon of the Arkansas, 1874, *George Engelmann.*

TEXAS: Fort Union, Upper Cimmaron, 1859, *Newberry* (McComb's Exped.); Hurrah Creek and Llano Estacado 1853–4, *Bigelow* (Whipple Exped.); Cañon of Pecos River, 1883, *V. Havard;* El Paso, 1880, *G. R. Vasey;* Buffalo Gap Mountains, 1881, *Havard;* Mouth of Pecos River, *Bigelow* (Mex. Bound. Surv.); Kerrville, 1899–1900, *Havard & Lacey.*

MEW MEXICO: 1865, *E. Palmer.*

ARIZONA: Swisshelm Mountains 1894, *Toumey;* 1869, *E. Palmer.*

ILLUSTRATIONS: *Pl. 30. f. 4;* Torr. Ann. Lyc. N. Y. *pl. 4* (except fruit); Nutt. Silva, *pl. 3* (poor); Greene, W. Am. Oaks, *pl. 30;* Sargent, Silva N. Am. *pl. 385. f. 1, 4* (?).

Quercus undulata Vaseyana (Buckl.).

Quercus Vaseyana Buckley, Bull. Torr. Club. **10**: 91. 1883.

More glabrate: leaves narrowly oblong, deeper undulate; acorn usually shorter, 8–10 mm. long.

TEXAS: Near Pecos River, *Buckley;* Head of Devil's River, *Parry* (Mex. Bound. Surv.); Meyers Spring and Mountains near Presidio, 1880, *Dr. Havard;* Mouth of Pecos, 1852 (Mex. Bound. Surv.).

ILLUSTRATION: *Pl. 30. f. 5.*

19. Quercus Mohriana Buckley.*

A small shrub. Bark of the branches dark gray; that of the twigs lighter and stellate-pubescent: bud-scales brown, pubescent: petioles very short, 2–3 mm. long: leaf-blades thick, oblong or oval, entire, undulate or sometimes sinuately toothed, pale bluish or brownish green, shining and glabrate above, gray or white stellate-pubescent beneath, 3–5 cm. long, obtuse or cordate at the base, obtuse or acute at the apex: cup hemispheric, 13–15 mm. wide; scales ovate, corky-thickened on the back; acorn barrel-shaped, about 15 mm. long and 10–12 mm. broad.

This may easily be mistaken for an entire-leaved form of *Q. undulata*, but the pubescence of the lower surface of the leaves is whiter, almost like that of *Q. breviloba*, and the acorn is much thicker and shorter. The more sinuate leaves resemble those of *Q. undulata*. The entire leaves are like those of *Q. grisea*, but lack the yellowish tinge of the pubescence of that species. A local shrub of western Texas and adjacent Mexico.

TEXAS: Valley of Devil's River, 1875, *S. B. Buckley* (*type*); San Pedro River, *Bigelow* (Mex. Bound. Surv.); Sand hills, 1881, *Dr. Havard.*

MEXICO: States of Coahuila and Nuevo Leon, 1880, *Palmer, 1178.*

ILLUSTRATIONS: *Pl. 31. f. 1–2.*

20. QUERCUS GRISEA Liebm. Oversigt Dansk. Vidensk. Selsk. Forhandl. 1854: 171.

Quercus undulata var. *grisea* Engelm. Trans. St. Louis Acad. 3: 393. 1877.

Quercus oblongifolia Torr. Mex. Bound. Surv. 206, in part. 1859.

Quercus undulata Sargent, Silva N. Am. 8: 75, in part. 1895.

A shrub usually a few meters high, rarely a small tree. Bark of stems and branches gray, flaky, that of the younger twigs

* This was never published by Buckley, so far as I can find. The name has existed in herbaria for so many years, that it would cause much confusion if I were to ignore it and adopt another name for the species.

yellowish and stellate-pubescent: leaf buds brown, pubescent: petioles about 5 mm. long densely stellate; leaves from oval to oblong or sometimes oblong-lanceolate, acute at the apex, cordate or rounded at the base, usually entire or undulate, sometimes, especially on young shoots, dentate, 2–5 cm. long; upper surface pale bluish green, at first stellate, in age glabrate and shining; lower surface densely stellate and fulvous: cup shallow, about 12 mm. wide and 5 mm. deep: scales ovate and corky-thickened; acorns ovoid or barrel-shaped, obtuse or acutish, about 15 mm. long.

The leaf-form is rather variable in *Q. grisea*. Sometimes the leaves are more reticulate, when it is hard to distinguish it from *Q. Arizonica;* the acorns are, however, usually shorter and the cup shallower. The shallow cup with more corky scales and the more or less yellowish tinge of the pubescence on the lower surface of the leaves are the only characters that distinguish it from *Q. Mohriana*. Sometimes the leaves are broader below the middle and slightly spinulose-dentate, when they closely resemble those of *Q. Emoryi* in form; but in that species the leaves are glabrous when mature. On young shoots the leaves are often sinuately toothed, when they resemble those of *Q. undulata*, but differ in the dense yellowish pubescence beneath. *Q. grisea* belongs to the Staked Plains rather than to the mountains and its distribution is more easterly than that of *Q. Arizonica*, but the ranges of the two overlap.

TEXAS: 1849, *Wright, 665* (type); Painter Camp, 1850, *Bigelow* (Mex. Bound. Surv.); Muerta Spring, 1881, *Dr. V. Havard;* Eagle Mountain, *Havard;* Independence Spring, *Havard*.

NEW MEXICO: Santa Magdalena Mountains, 1881, *G. R. Vasey;* Puerto de Pajaros, 1852, *Bigelow* (Mex. Bound. Surv.); 1851–2, *C. Wright, 1866;* Silver City, 1880, *Greene;* Organ Mountains, 1881, *G. R. Vasey;* 1881, *H. H. Rusby*.

ARIZONA: 1874, *Rothrock;* Date Creek, 1870, *E. Peters;* Chiricahua Mountains, 1894, *Toumey, 182*.

ILLUSTRATIONS: *Pl. 32. f. 1;* Oersted, Liebm. Chenes Am. Trop. *pl. 46. f. 12;* Sargent, Silva N. Am. *pl. 385. f. 9*.

21. QUERCUS ARIZONICA Sargent, Gard. & Forest, **8**: 92. 1895.

Quercus undulata Greene, W. Am. Oaks, **1**: 27, in part. 1889.

Quercus Emoryi Wats. Pl. Wheeler, 17. 1874. Not Torr.

Quercus undulata var. *grisea* Engelm. Wheeler's Rep. **6**: 250, in part. 1878.

Quercus grisea Sarg. Forest Trees N. Am. 10th Census U. S. **9**: 144, in part. 1884. Not Liebm.

A tree occasionally 15–18 m. high. Bark of the stem gray, usually cracked, fissured and scaly, that of the branches gray or yellow, the young branches densely fulvous stellate; leaf-buds brown, pubescent: petioles 4–8 mm. long, stellate: leaf-blades oblong or oblong-oval, acute, obtuse or cordate at the base, firm, sinuate-dentate with mucronate or spinulose teeth, 2–8 cm. long; upper surface pale bluish or yellowish green, not very shiny; lower surface strongly reticulate, stellate-puberulent, pale yellowish: fruit short-peduncled: cup hemispheric, 10–12 mm. in diameter; scales ovate, strongly corky-thickened on the back; acorn oblong-ellipsoid or elongated barrel-shaped, usually 2–2.5 cm. long, obtuse, light yellowish brown.

This species is very variable and seems to grade into *Q. reticulata* on the one hand and *Q. grisea* on the other. Two specimens cited below, collected in the Huachuca Mountains by Wilcox and Toumey seem to be intermediate between *Q. Arizonica* and *Q. reticulata.* The shape of the leaves is that of the former but their size and obtuse apices suggest the latter. Neither has any fruit, which would otherwise help the determination, as *Q. reticuluta* usually has shorter and thinner cup-scales.

It is still harder to distinguish this oak from *Q. grisea.* As a rule the latter has also shorter acorns and less distinct reticulation. Professor Sargent cites *Quercus undulata* var. *grisea* Engelm. Wheeler's Rep. **6**: 250 as a synonym of *Q. Arizonica;* this is only partly true, for one of Rothrock's specimens in the U. S. National Herbarium is exactly like Wright's no. 665 in the Torrey herbarium. The latter is the

type number of *Q. grisea*. On account of the slight and not constant differences between *Q. Arizonica* and *Q. grisea*, I have been inclined to reduce the former to a subspecies with more reticulate leaves; but perhaps it is better to regard them as distinct although intermediate forms are apparently not lacking. *Q. Arizonica* is the most common of the life-oaks of Arizona, growing at an elevation of 1500 to 3000 m.

ARIZONA: San Francisco Mountains, 1853, *Bigelow* (Whipple Exploration, mixed with *Q. pungens*); Huachuca Mountains, 1894 and 1895, *Toumey;* Santa Catalina Mountains, 1894, *Toumey*; Swisshelm Mountains, 1893, *Toumey*; Ft. Huachuca, 1892 and 1893, *Dr. Wilcox*, also 1894, *457, 369, 341, 448, 493, 493b, 496, 504, 449;* 1872, *Wheeler's Expedition; Dr. E. Palmer;* Lowell, 1884, *W. F. Parish;* Santa Rita Mountains, 1881, *C. G. Pringle;* Santa Catalina Mountains, 1881, *Pringle, 14;* also in 1884; Santa Rita Mountains, 1880, *Englemann & Sargent.*

NEW MEXICO: Organ Mountains, 1881, *G. R. Vasey;* Camp Bowie, 1874, *Rothrock, 508;* Bear Mountains, 1880, *Rusby.*

MEXICO: Chihuahua, Guadalupe Cañon, 1852, *Thurber, 766.*

ILLUSTRATIONS: *Pl. 31. f. 3–4;* Greene, W. Am. Oaks, *pl. 13. f. 3; pl. 14;* Sargent, Silva N. Am. *pl. 389.*

22. QUERCUS RETICULATA Humb. & Bonpl. Pl. Aequin. **2**: 40. 1809.

In Mexico a large tree, but within United States a small tree or shrub only a few meters high. Bark of the trunk brown, more or less scaly, that of the branches brown or yellowish, more or less fulvous stellate-pubescent: leaf-buds brown or reddish, ciliate: petioles very short, 3–5 mm. long, stellate-pubescent: leaf-blades obovate, 4–12 cm. long, cordate or rounded at the base, rounded obtuse or short-acuminate at the apex, sinuately dentate above the middle, or entire; teeth mucronate, or with short spinulose tips; upper surface pale bluish green, in age shining, when young more or less densely stellate: lower surface strongly reticulate, fulvous with dense stellate pubescence: fruit generally pe-

duncled: cup shallow, 3–4 mm. deep, 10–14 mm. wide; scales ovate, brown, pubescent, slightly thickened on the back; acorn ellipsoid or barrel-shaped, mostly obtuse, 12–15 mm. long, brown, pubescent when young.

In the United States this is only found in the States of Arizona and New Mexico, and reaches an altitude of about 1000 m.; there it is only a small tree or shrub, but in Mexico it reaches considerable size. It differs from its nearest relatives of the region in the larger, thicker, strongly reticulate and strongly pubescent leaves. Distinct as it seems to be there are certain forms that seem to connect it with *Q. Arizonica* of the same region. Professor Sargent's description and illustration of this species are excellent.

ARIZONA: Chiricahua Mountains, 1894, *Toumey;* Mt. Graham, 1874, *Rothrock;* San Francisco Mountains, *Capt. E. K. Smith;* Fort Huachuca, 1894, *T. E. Wilcox;* Dragon Mountains, 1881, *Vasey;* Santa Rita Mountains, 1881, *C. G. Pringle;* San Francisco Mountains, *Greene.*

MEXICO: Patzuaro, 1892, *C. G. Pringle, 4116;* Real del Monte, 1848–9, *Dr. J. Gregg, 638a;* Sierre Madre, State of Chihuahua, 1888, *Pringle, 2021;* 1840, *Hartweg.*

ILLUSTRATIONS: *Pl. 31. f. 5;* Humb. & Bonpl. Pl. Aquin. *pl. 86;* Oersted, Liebm. Chenes Am. Trop. *pl. H; pl. 34. f. 10–16; pl. 35. f. 15–22;* Greene, W. Am. Oaks, *pl. 16;* Sargent, Silva N. A. *pl. 390.*

23. QUERCUS OBLONGIFOLIA Torrey, Sitgreaves' Rep. 173. 1853.

Quercus undulata var. *oblongata* Engelm. Wheeler's Rep. **6**: 250. 1878.

Quercus undulata δ grisea Wenzig, Jahrb. Bot. Gart. Berlin, **3**: 200, in part. 1885.

A tree, seldom over 9 m. high. Bark of the trunk ashy gray, checkered; that of the branches gray or brownish, puberulent only when young: bud-scales brown, at first tomentose: petioles 2–3 mm. long: blades oblong, obtuse, 3–6 cm. long, obtuse at the apex, obtuse or cordate at the base, in age perfectly glabrous, pale bluish green on both sides, entire or on young shoots dentate, rarely spinulose toothed: cup hemispheric,

10–14 cm. in diameter; scales strongly corky-thickened on the back; acorn ellipsoid or somewhat ovoid, about 12–15 mm. long.

Q. oblongifolia is nearest related to *Q. grisea* but differs in the glabrous leaves, and larger size of the tree.

ARIZONA: 1851, *D. Woodhouse* (Sitgr. Exped.); Fort Huachuca, 1892, *T. E. Wilcox;* Santa Catalina Mountains, 1894, *J. W. Toumey;* Penel Mountains, 1894, *Toumey;* Santa Catalina Mountains, 1881, *C. G. Pringle;* San Gabriel Mountains, 1880, *Engelmann & Sargent.*

CALIFORNIA: San Diego County, 1880, *G. R. Vasey;* 1881, *S. B. & W. F. Parish*; Santa Isabel, 1858, *S. Hayes.*

NEW MEXICO: Mogollon Mountains, *H. H. Rusby.*

MEXICO: Ojito, 1847, *Dr. Gregg.*

ILLUSTRATIONS: *Pl. 32. f. 2–3;* Torr. Sitgreaves' Rep. *pl. 19;* Greene, W. Am. Oaks, *pl. 15. f. 1;* Sargent, Silva N. Am. *pl. 388.*

24. QUERCUS EMORYI Torr. Emory's Rep. 151. 1848.

Quercus hastata Liebm. Oversigt Dansk. Vidensk. Selsk. Forh. 1854: 171.

A tree 9–12 m., or rarely 20 m. high with a trunk 6–12 dm. in diameter. Bark of the trunk dark brown, deeply furrowed and scaly, that of the branches reddish brown with numerous lenticels, the young branchlets somewhat stellate: buds brown, puberulent: petioles 2–5 mm. long: leaf-blades lanceolate, ovate-lanceolate or oblong-lanceolate, thick and firm, rounded, truncate or cordate at the base, acute or acuminate and spinulose-tipped at the apex, entire or with a few sinuate spinulose-tipped teeth, pale bluish or yellowish green and shining above, paler and duller beneath, perfectly glabrous on both sides or slightly stellate and puberulent when young, 2–7 cm. long: cup sessile, hemispheric, about 10 mm. in diameter; scales thin, scarcely thickened on the back, round-ovate, obtuse, light brown, puberulent and stellate-ciliate on the margin; acorn elongated-ovate, acute, 15–20 mm. long and 8 mm. in diameter, light brown and somewhat striate, puberulent when young.

Specimens with entire leaves much resemble *Q. oblongifolia* as to the leaves, but the species is easily distinguished in fruit by the thin rounded cup-scales. From *Q. Toumeyi,*

it differs in the larger, more lanceolate, more acute and lighter green leaves and the form of the cup-scales; in *Q. Toumeyi* these are ovate-deltoid, obtuse, not rounded. *Q. Emoryi* is the most common live-oak of the region, growing principally in the mountain regions. *Q. hastata* Liebm. was described from a specimen with subentire leaves, cordate at the base. See *pl. 32. f. 5*.

TEXAS: Ft. Davis, *Blake, 5;* gravelly hills on the Limpia, *Bigelow* (Mex. Bound. Surv.); western Texas, 1849, *Wright, 666*.

NEW MEXICO: Bear Mountains, 1881, *H. H. Rusby, 387;* Sierra del Pajarito, *Schott;* 1851–2, *C. Wright, 1865* (*Q. hastata* Liebm.); Pigeon Creek, 1846, *W. H. Emory* (type).

ARIZONA: Santa Catalina Mountains, 1894, *J. W. Toumey;* 1881, *Pringle;* Santa Rita Mountains, 1884, *C. S. Pringle;* Huachuca Mountains, 1895, *Toumey;* Ft. Huachuca, 1891, *T. E. Wilcox;* Santa Rita Mountains, 1894, *Toumey;* 1869, *E. Palmer;* Central Arizona, 1874, *Rothrock, 287*.

MEXICO: Sonora, *Capt. E. K. Smith;* southwest Chihuahua, 1885, *E. Palmer*, 302.

ILLUSTRATIONS: *Pl. 32. f. 4, 5;* Emory's Rep. *pl. 9;* Oersted, Liebm. Chenes Am. Trop. *pl. 46. f. 3, 4*.

25. QUERCUS TOUMEYI Sargent, Gard. & Forest, **8**: 92. 1895.

A tree 7–10 m. high. Bark of the trunk dark brown, furrowed, scaly, that of the older branches almost black, of the young shoots red, tomentose and with dark hairs: petioles 2–3 mm. long: leaf-blades oblong, ovate-oblong or oval, rounded or cordate at the base, acute at the apex, remotely sinuately dentate with mucronate or slightly spinulose-tipped teeth, glabrous and shining, pale bluish green above, puberulent or in age glabrate beneath, 2–3 cm. long: fruit sessile: cup shallow, covering about one-fourth of the acorn, which is ellipsoid or ovoid, 12–16 mm. long and light brown.

This species is, as far as the leaves are concerned, nearest to the Californian *Q. dumosa* but is easily distinguished by the small acorn. I have seen only one specimen.

ARIZONA: Bisbee, 1895, *J. W. Toumey*.

Illustrations: *Pl. 32. f. 6;* Garden & Forest, **8**: *pl. 13, 14;* Sargent, Silva N. Am. *pl. 391.*

26. Quercus turbinella Greene, West Am. Oaks **1**: 37 & **2**: 59. 1889–90.

Quercus berberidifolia A. DC. Prod. **16**²: 36, in part. 1864. Scarcely Liebm.

Quercus Emoryi Torr. Mex. Bound. Surv. 206, in part. 1859. Engelm. Wheeler's Rep. **6**: 250. 1878.

Quercus undulata δ Wrightii Engelm. Trans. St. Louis Acad. **3**: 282, in part (?). 1876.

Quercus undulata Sargent, Silva **8**: 75, in part. 1895.

A shrub 1–3 m. high. Bark of the stems and branches dark brown or dark gray, that of the young branchlets covered with a white stellate pubescence and when young with fulvous tomentum: petioles 2–3 mm. long: leaf-blades oblong, elliptic, oval or rarely ovate, 1–3 cm. long, obtuse or cordate at the base, acute at the apex, usually sinuate-dentate with spinulose-tipped teeth, when unfolding covered with a fulvous tomentum; upper surface in age light bluish green and shining; lower surface strongly reticulate, fulvous, stellate-pubescent, or when very old occasionally glabrous: cup hemispheric, usually more or less turbinate at the base, 8–10 mm. in diameter; scales deltoid-ovate, obtuse, moderately corky-thickened on the back especially those at the base; acorn elongated-ovoid, acute, 15–20 mm. long, 8 mm. in diameter.

Professor Sargent refers *Q. turbinella* partly to *Q. undulata* and partly to *Q. dumosa*, from both of which the species is easily separated by the fulvous tomentum, the turbinate cup and the small elongated-ovoid acorn. The type of *Q. turbinella* matches exactly Wright's no. 1868. The latter was a part of *Q. berberidifolia* in DeCandolle's Prodromus, but it is scarcely *Q. berberidifolia* of Liebman, for there are several discrepancies. Liebman's figure illustrates a plant with larger leaves and his description states that the leaves are "subtus pruinoso-glauscentia" and that the cups are "depresso-hemisphaerica." DeCandolle also points out these discrepancies; he had evidently not studied Liebman's type or any authentic specimen and does not claim to have done so.

Q. turbinella belongs probably to the *Q. chrysolepis* group, and evidently close to *Q. vacciniifolia* Kellogg, but lacks the white bloom usually found on the lower surface of the leaves of the latter; the teeth are more distant and more decidedly spinulose tipped, and the cup is more turbinate.

LOWER CALIFORNIA: 1888, *Geo. V. Dunn* (type).

CALIFORNIA: San Bernardino Mountains, 1894, *S. B. Parish, 2986 and 2987;* California Desert, 1876, *C. C. Parry, 1;* San Jacinto Mountains, 1898, *J. B. Leiberg, 3160.*

NEVADA: Mica Spring, 1894, *M. E. Jones, 5059;* 1872, *Wheeler;* Charleston Mountains, 1891, *Coville & Funston, 385.*

ARIZONA: Big Bug, 1891, *J. W. Toumey;* Chiricahua Mountains, 1894, *Toumey;* Gallun Mountains, 1894, *Toumey;* Bradshaw Mountains, 1894, *Toumey;* 1869, *Ed. Palmer;* Santa Catalina Mountains, 1894, *Toumey.*

UTAH: Springdale, 1894, *M. E. Jones, 6080.*

NEW MEXICO: Grant County, 1880–1, *H. H. Rusby, 388;* Cook's Spring, 1851, *Bigelow* (Mex. Bound. Surv.); *Woodhouse* (Sitgreaves' Exp.); 1851–2, *C. Wright*, 1868; Yampai Creek, 1851 (Mex. Bound. Surv.); Organ Mountain, 1897, *E. O. Wooton, 547* (unusually large leaves); Silver City, 1880, *E. L. Greene.*

Some of the specimens from Arizona have subentire leaves and then resemble closely *Q. vacciniifolia.* To this form belong the following specimens:

ARIZONA: Chiricahua Mountains, 1894, *Toumey, 174;* Huachuca Mountains, 1895, *Toumey;* Fort Huachuca, 1892, *T. E. Wilcox.*

SONORA: *Capt. E. K. Smith.*

ILLUSTRATIONS: *Pl. 33. f. 1, 2;* Greene, W. Am. Oaks, *pl. 27;* Sargent, Silva N. Am. *pl. 385. f. 10–12.*

27. **Quercus Wilcoxii** sp. nov.

Quercus chrysolepis var. Greene, Pittonia, **2**: 112. 1890.

Quercus chrysolepis Sargent, Silva N. Am. **8**: 105, in part. 1895.

A shrub or rarely a small tree, 6–9 m. high. Bark of trunk and branches dark gray or brownish, that of the young branchlets fulvous-tomentulose: bud-scales brown, tomentulose: petioles 3–5 mm. long: leaf-blades usually broadly oval, acute at the base, abruptly short-acuminate, thick and firm, 1–4 cm. long, when young deciduously fulvous stellate-tomentulose especially on the lower surface, in age pale yellowish green, glabrous and shining above, dull white and punctate beneath with many lateral veins and obsolete reticulation, usually entire or with a few spinulose-tipped teeth; those of the sterile shoots very unlike the usual form, almost orbicular or round-ovate in outline, obtuse or cordate at the base, coarsely and deeply dentate with lanceolate or triangular, divergent spinose-tipped teeth: cup hemispheric, 10–14 mm. in diameter; scales ovate, fulvous-stellate, only slightly thickened and green on the back, with brown acute tips; acorn ovoid, about 15 mm. long, light brown.

Q. Wilcoxii is closely allied to *Q. chrysolepis* and has been confused with it, but differs in the shorter and broader, abruptly acuminate leaves, the smaller acorn, the smaller and deeper cup and the less thickened scales. All the acorns examined evidently lacked all traces of pubescence on the inside characteristic of *Q. chrysolepis.*

Q. Wilcoxii grows in the mountain regions of Arizona. All specimens seen by me, except two, are from that State. The specimens of *Q. chrysolepis* from New Mexico and Sonora, mentioned by Professor Sargent probably also belong here.

ARIZONA: Fort Huachuca, 1892, *T. E. Wilcox* (type in Columbia Univ. Herb.); Huachuca Mountains, 1895, *J. W. Toumey;* Massatzal Mountains, 1867, *Dr. Smart, 204* (young shoot in flower); 1871, *Wheeler* (leaf from shoot); Santa Rita Mountains, 1881, *C. G. Pringle.*

UTAH: Washington, 1874, *C. C. Parry* (young shoot).

NEVADA: 1872, *Lt. Wheeler* (young shoot).

ILLUSTRATIONS: *Pl. 33. f. 3–4.*

28. QUERCUS HYPOLEUCA Engelm. Trans. St. Louis Acad. **3**: 384. 1876.

Quercus confertifolia Torr. Bot. Mex. Bound. Surv. 207. 1858. Not H.B.K.

Quercus Mexicana γ confertifolia Wenzig, Jahrb. Bot. Gart. Berlin, **3**: 209. 1883.

A tree 6–10, seldom 15 m. high, with a trunk 2.5–4 dm. in diameter. Bark of the trunk nearly black and deeply furrowed and scaly; that of the branches dull brown with numerous lenticels; the branchlets more or less densely white stellate-puberulent: leaf-buds densely stellate: petioles 3–10 mm. long: leaf-blades lanceolate, acute at the base, long-attenuate at the apex, entire or sinuately dentate with spinulose-tipped teeth, 5–10 cm. long, with revolute margins, very thick and firm, pale yellowish green, glabrous or at first slightly puberulent above, densely white-stellate beneath: cup hemispheric or slightly turbinate, 10–13 mm. in diameter; scales ovate, brown, rather thin, not corky on the back, stellate-puberulent; acorn avoid, acutish, 15–18 mm. long, light brown, when young stellate-puberulent.

Q. hypoleuca grows in the mountain regions at an altitude of about 2000 m. on hillsides and in cañons scattered among the pines. It is not closely related to any of the other species of the region.

Arizona: Santa Rita Mountains, 1881, *C. G. Pringle;* Huachuca Mountains, 1895, *J. W. Toumey;* Ft. Huachuca, 1892, *Dr. Wilcox;* San Francisco Mountains, *Capt. E. K. Smith;* Huachuca Mountains, 1894, *Dr. Wilcox.*

New Mexico: Bear Mountains, 1880, *H. H. Rusby, 385;* Sierra del Pajarito, 1869, *Schott;* Copper Mines, 1851–2, *C. Wright, 1869;* Pinos Altos Mountains, 1880, *E. L. Greene.*

Illustrations: *Pl. 33. f. 5–6;* Greene, W. Am. Oaks, *pl. 6;* Sargent, Silva N. Am. *pl. 405.*

29. Quercus Texana Buckley, Proc. Phil. Acad. 1860: 444.

Quercus coccinea var. ? *microcarpa* Torr. Bot. Mex. Bound. Surv. 206. 1858. Not *Q. microcarpa* Lapay.

Quercus rubra var. *Texana* Buckley, Proc. Acad. 1881: 123.

A small tree with spreading branches. Bark of the stem light-brown and scaly; that of the branches brown or greenish and that of the twigs chestnut or reddish, glabrous: bud-

scales glabrous, chestnut-brown: petioles 1–3 cm. long, slender, glabrous; leaf-blades 5–10 cm. long, broadly ovate in outline, lobed deeper than half-way to the midrib, glabrous and shining on both sides or hairy on the veins beneath, cuneate or truncate at the base; lobes 5–9, triangular, rarely toothed, acuminate and spinulose-tipped at the apex: fruit subsessile: cup hemispheric, 9–12 mm. broad; acorn oblong-ellipsoid, 12–14 mm. long.

This is the only red oak found in the region. It differs from *Q. rubra* in the deeper and wider sinuses of its smaller and more glossy leaves and in its deeper, paler and more tomentose cups. It does not really belong to the region, its home being Central Texas, but extends to the Limpio Mountains in the western part of that State.

Professor Sargent gave the range of this species as extending from Indiana and Florida to Arkansas and Texas. This depended upon the fact that he included in *Q. Texana* a quite distinct species.* In the true *Q. Texana* the lobes of the leaves are distinctly triangular and mostly entire and the cup hemispheric or even slightly turbinate at the base, while in the other species the lobes are more oblong and coarsely toothed and the cup is shallow, saucer-shaped. Professor Sargent's Plate 411 illustrates both species. Figs. 1–4 and 6 belong to *Q. Schneckii*, and 5 and 7 to *Q. Texana*.

TEXAS: Near Austin, *S. B. Buckley;* mouth of Pecos, *Bigelow* (Mex. Bound. Surv.); New Braunfels, 1851, *Lindheimer* (*fl*).

ILLUSTRATIONS: Sargent, Silva N. Am. *pl. 411. figs. 5* and *7*.

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* This has been segregated from *Q. Texana* by Dr. Britton and characterized as follows:

Quercus Schneckii Britton. A forest tree similar to *Q. rubra* and *Q. palustris*. Bark reddish-brown with broad ridges broken into plates; leaves mostly obcordate, bright green and shining above, paler and with tufts of wool in the axils beneath, 0.5–1.5 dm. long, truncate or broadly wedge-shaped at the base, deeply pinnatifid into 5–9 oblong or triangular lobes, which are coarsely few-toothed and bristle-tipped; styles short: cup saucer-shaped, 10–16 mm. broad, its scales appressed; acorns ovoid, 1–2.5 cm. long, three times as high as the cup. Ohio and South Indiana to Iowa, Missouri, Florida and Texas, April–May. Acorns ripe in Sept.–Oct. [*Q. Texana* Sargent in part, not Buckley; Ill. Fl. fig. 1230].

INDEX AND CROSS-REFERENCES.

New species or new combinations published here for the first time are in **bold face**; other recognized species are in SMALL CAPITALS; and synonyms in *italics*.

Explanation of the Plates.

PLATE 25.

1. *Quercus submollis* Rydb.
2. " *Utahensis* (A.DC.) Rydb.
3. " *Vreelandii* Rydb.

PLATE 26.

1. *Quercus leptophylla* Rydb.
2. " *Gunnisonii* (Torr.) Rydb.

PLATE 27.

1. *Quercus nitescens* Rydb.
2. " *Novo-Mexicana* (A.DC.) Rydb.

PLATE 28.

1. *Quercus Gambelii* Nutt.
2. " *Eastwoodiae* Rydb.
3. " *venustula* Greene.

PLATE 29.

1. *Quercus Fendleri* Liebm.
2. " *Havardi* Rydb.
3. " *obtusifolia* (A.DC.) Rydb.—leaves.
4. " " " " —fruit.

PLATE 30.

1. *Quercus breviloba* (Torr.) Sargent.
2. " *pauciloba* Rydb.
3. " *pungens* Liebm.
4. " *undulata* Torr.
5. " " *Vaseyana* (Buckl.) Rydb.—leaf.

PLATE 31.

1. *Quercus Mohriana* Buckley.
2. " " " leaf of young shoot.
3. " *Arizonica* Sargent.
4. " " " leaf of young shoot.
5. " *reticulata* Humb. & Bonpl.

PLATE 32.

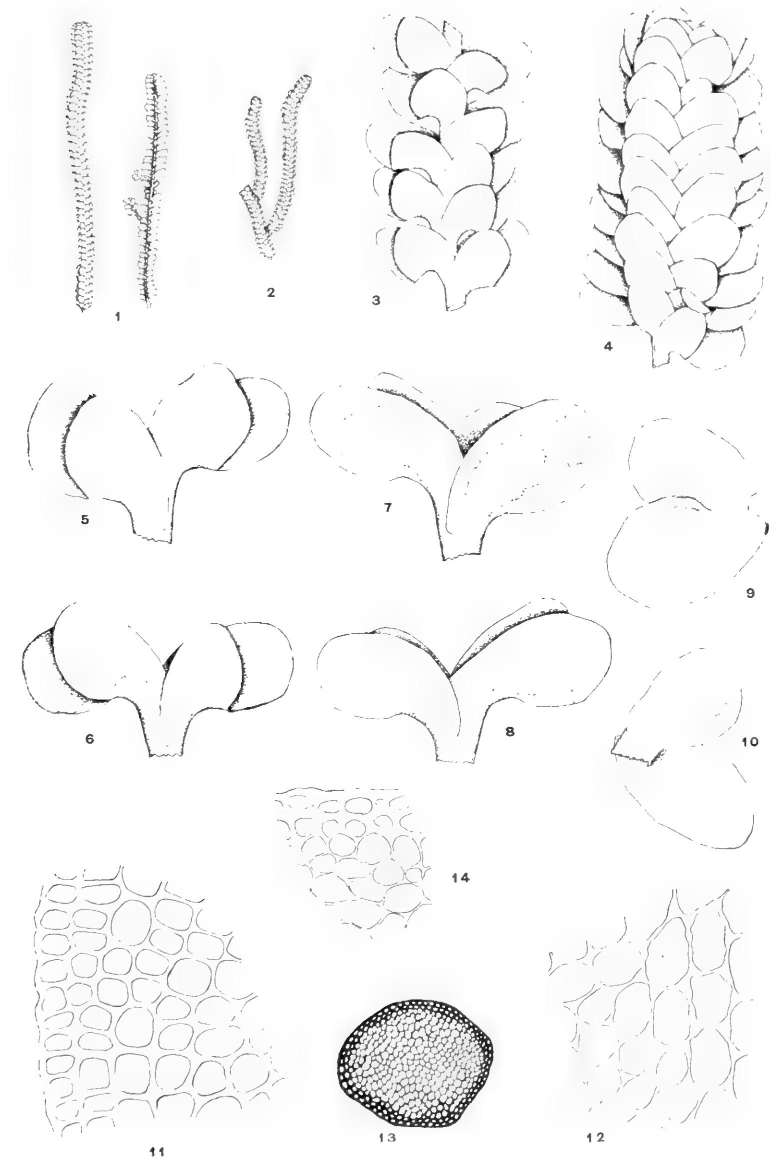
1. *Quercus grisea* Liebm.
2. " *oblongifolia* Torr.
3. " " " leaf of young shoot.
4. " *Emoryi* Torr.
5. " " leaf of the form described as *Q. hastata* Liebm.
6. " *Toumeyi* Sargent.

PLATE 33.

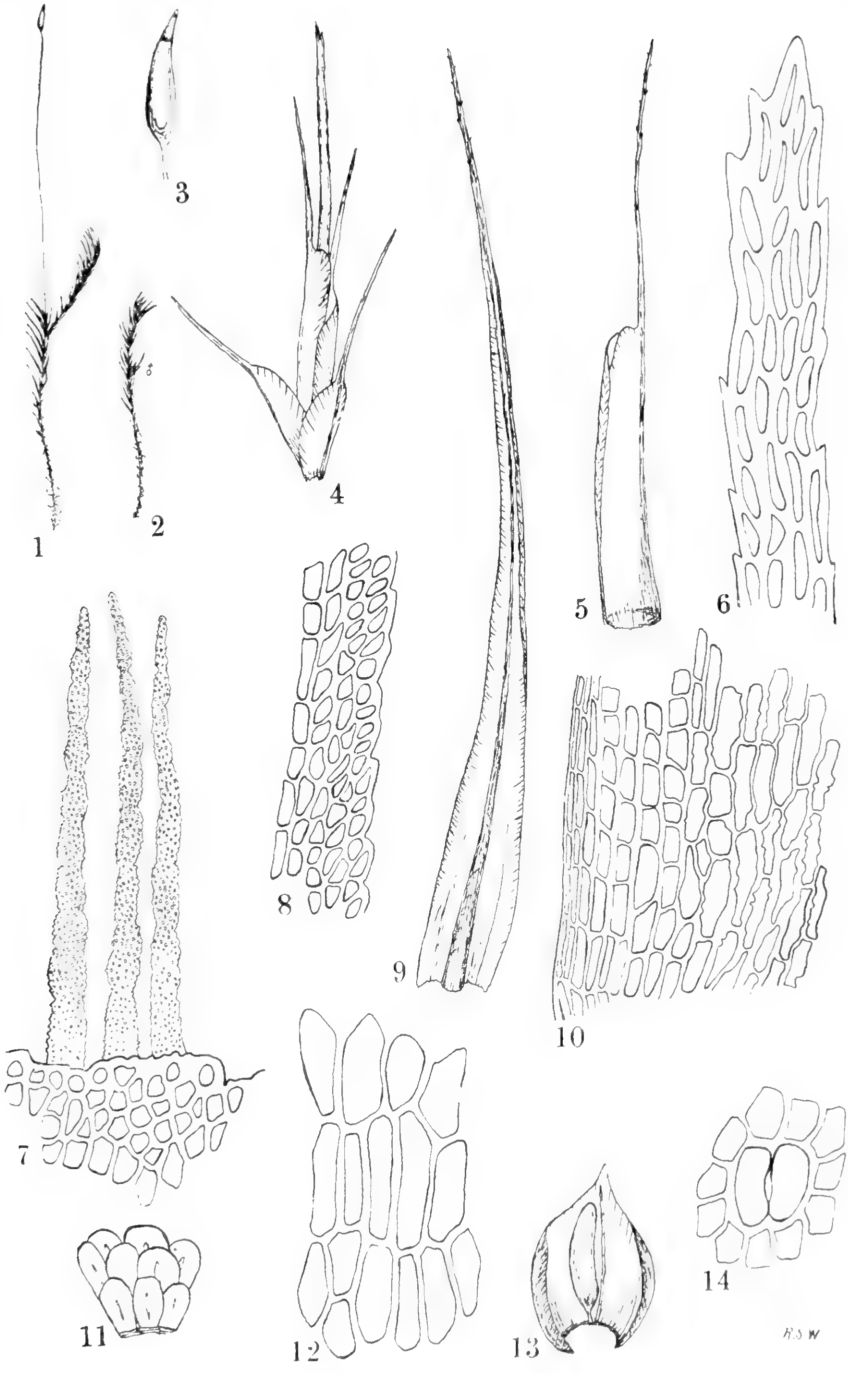
1. *Quercus turbinella* Greene, usual form.
2. " " " form with subentire leaves.
3. " *Wilcoxii* Rydb.
4. " " " leaf of young shoot.
5. " *hypoleuca* Engelm.
6. " " " leaf of shoot.

A *B*

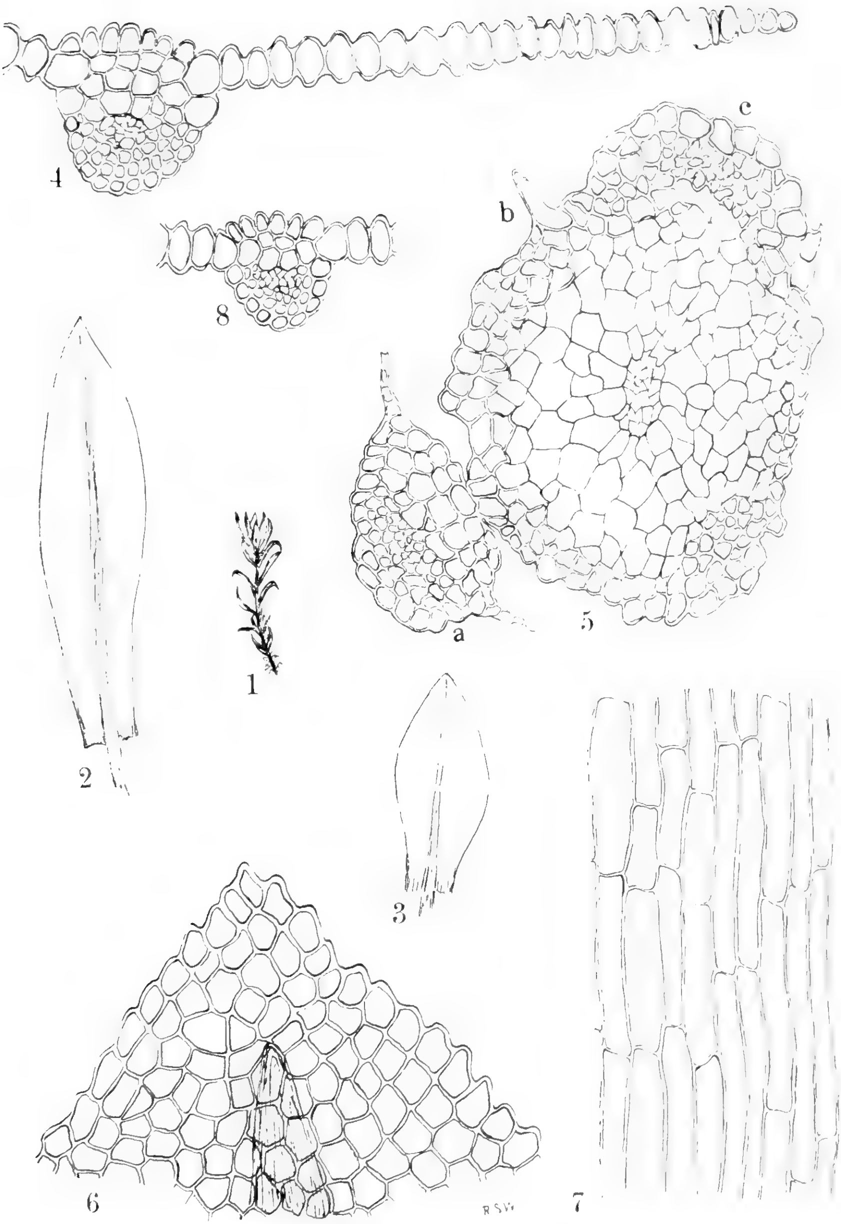
A, NORMAL SHOOT OF LYSIMACHIA TERRESTRIS BEARING SEED-PODS. *B*, SHOOT OF LYSIMACHIA TERRESTRIS GROWN IN DIFFUSE LIGHT BEARING BULBILS.



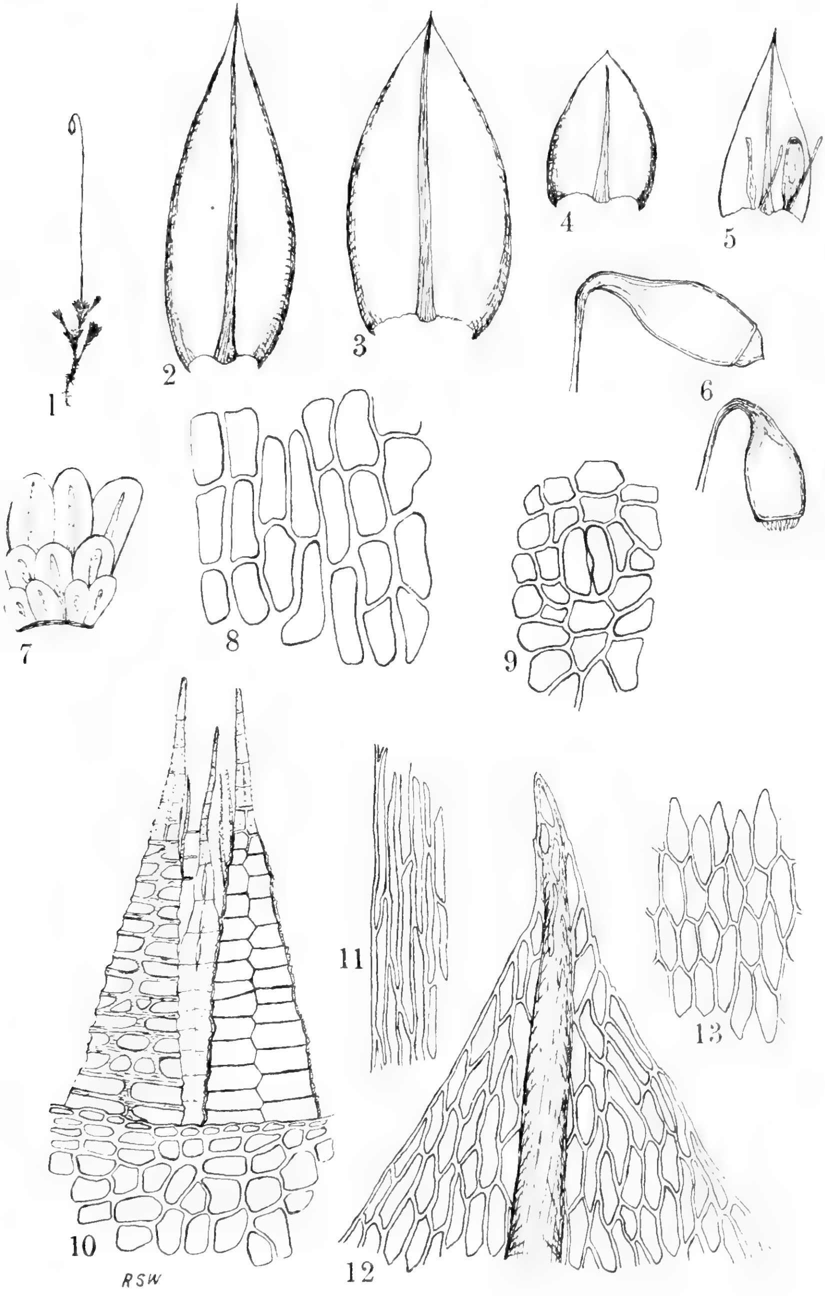
SCAPANIA IMBRICATA M. A. HOWE.



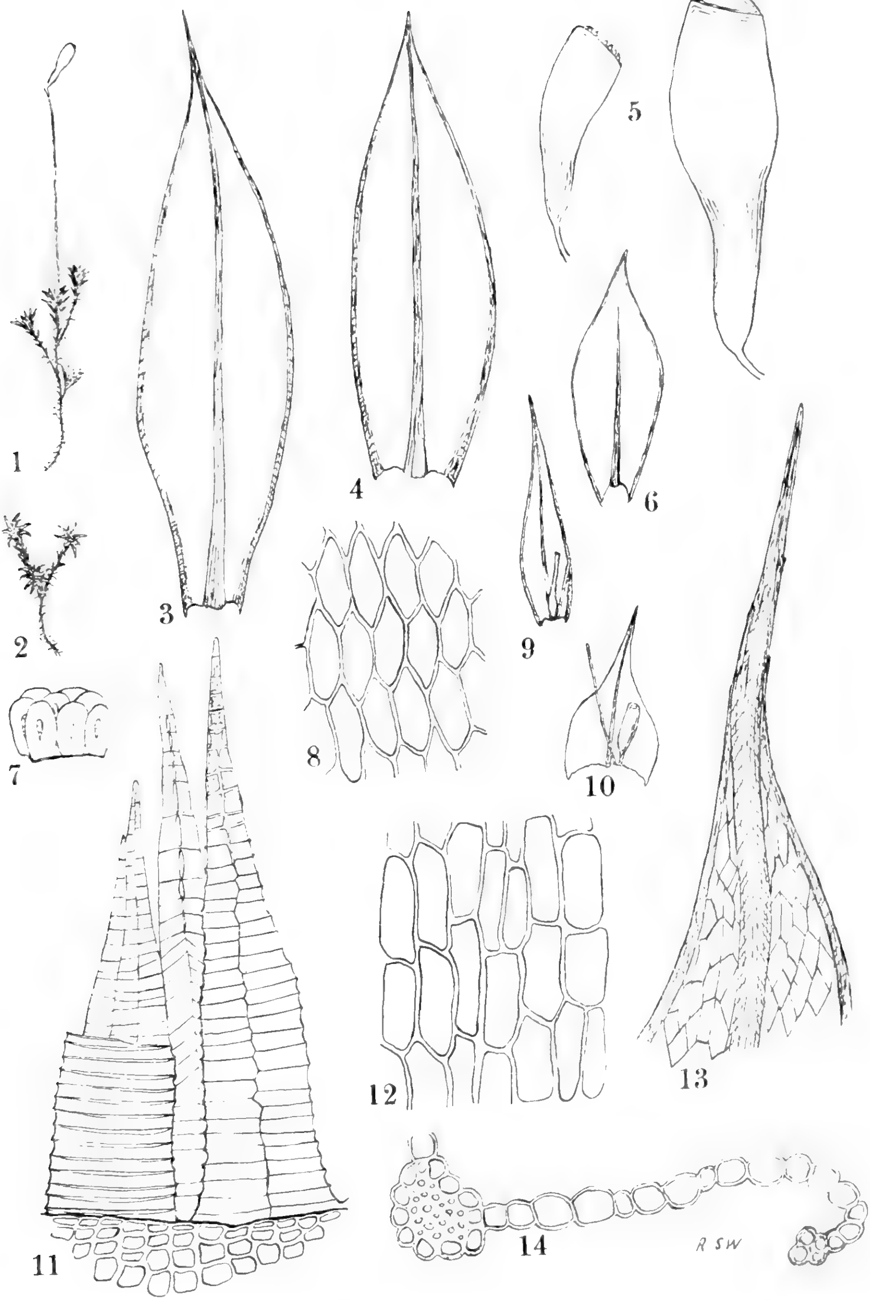
DITRICHUM GIGANTEUM R. S. WILLIAMS.



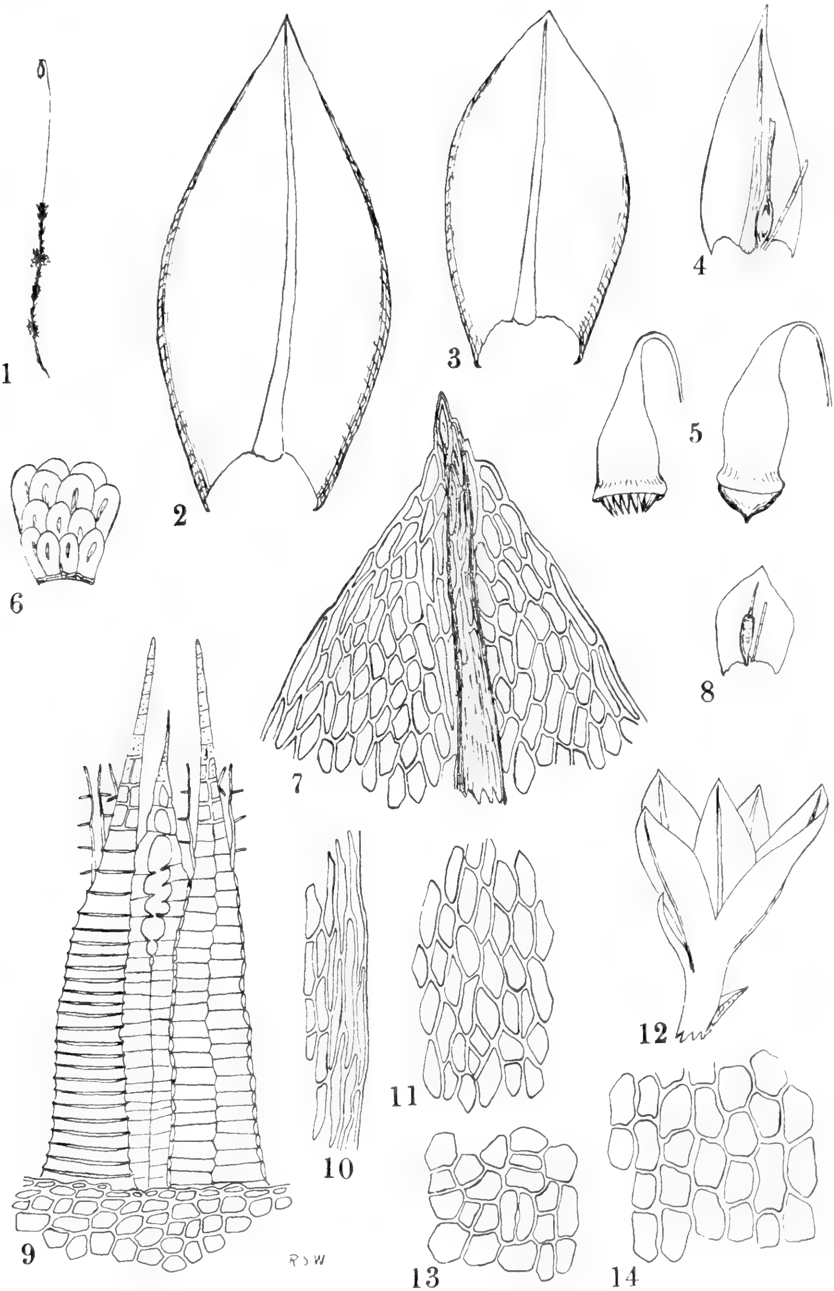
BRYOBRITTONIA PELLUCIDA R. S. WILLIAMS.



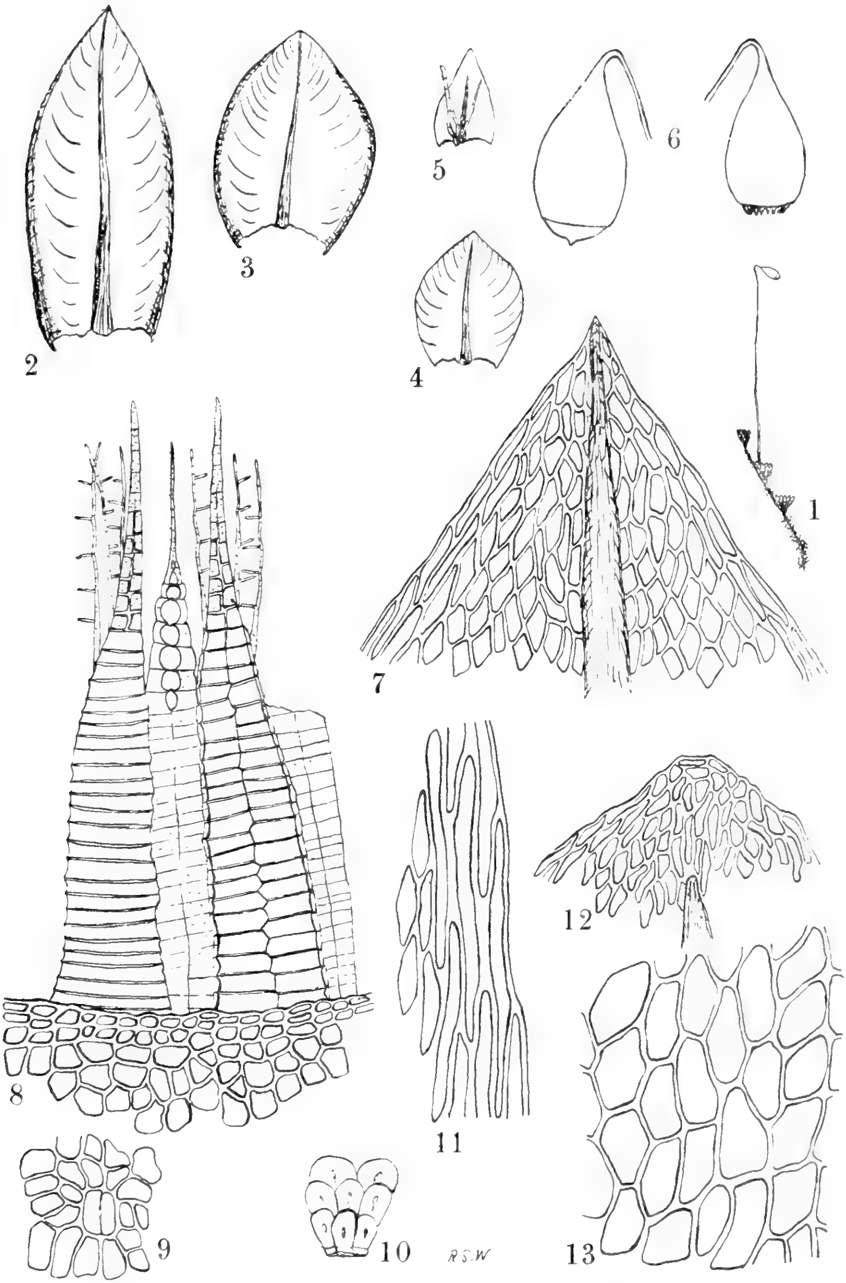
BRYUM DAWSONENSE R. S. WILLIAMS.



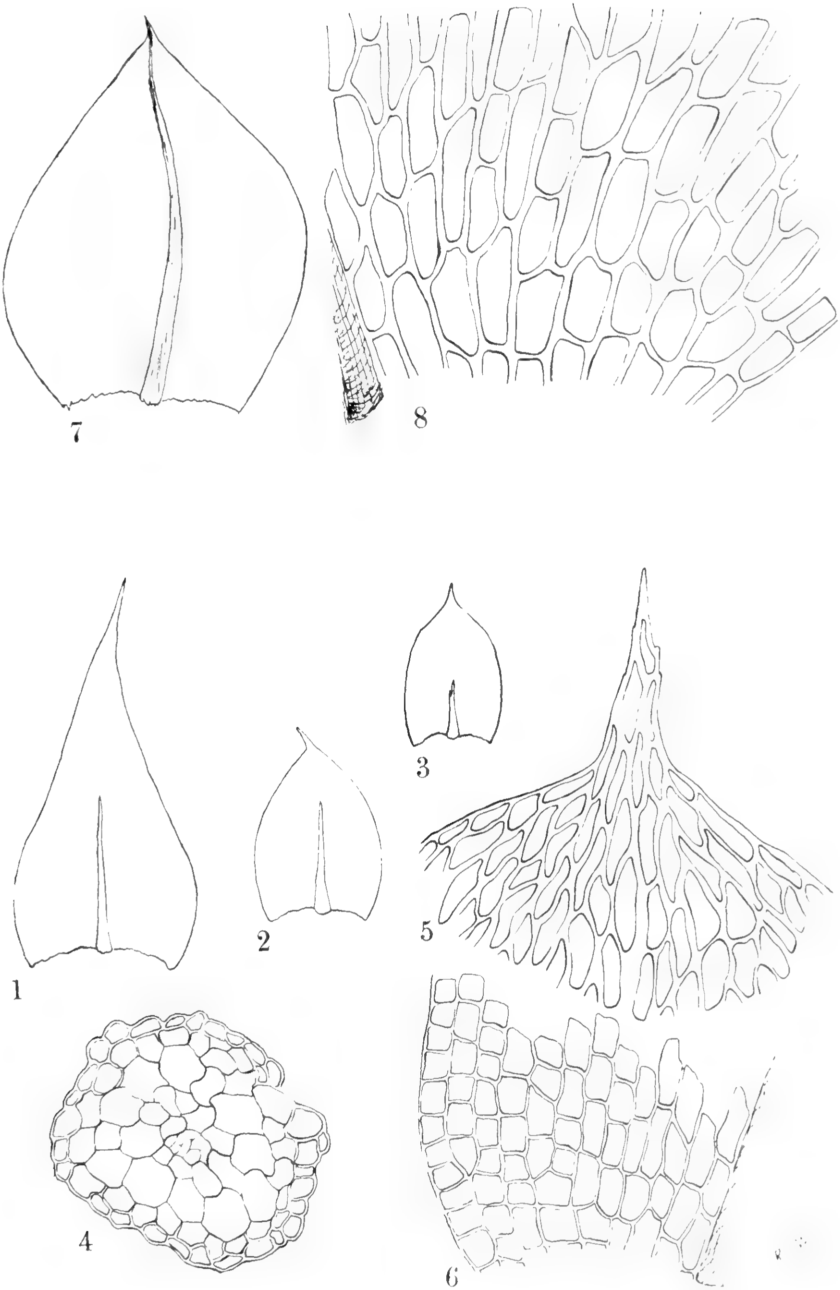
BRYUM CONDITUM R. S. WILLIAMS.



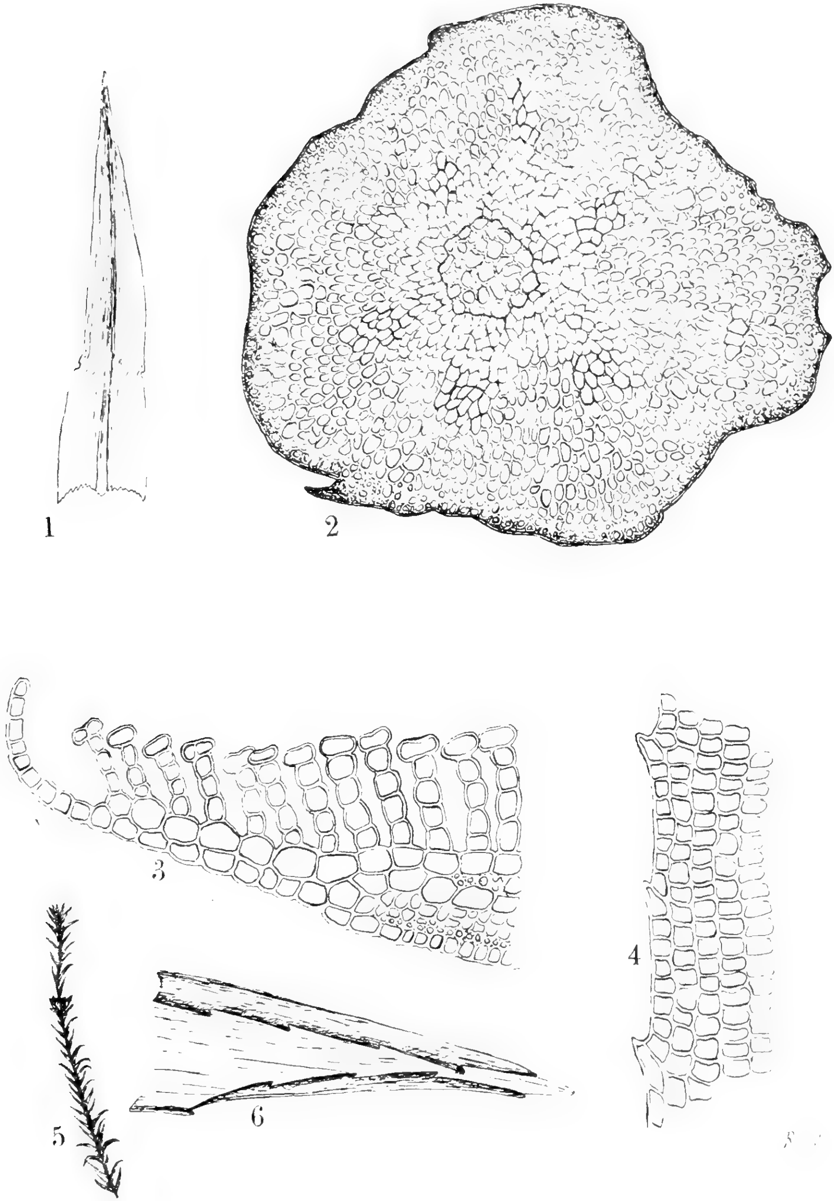
BRYUM SUBMUTICUM PHILIBERT.



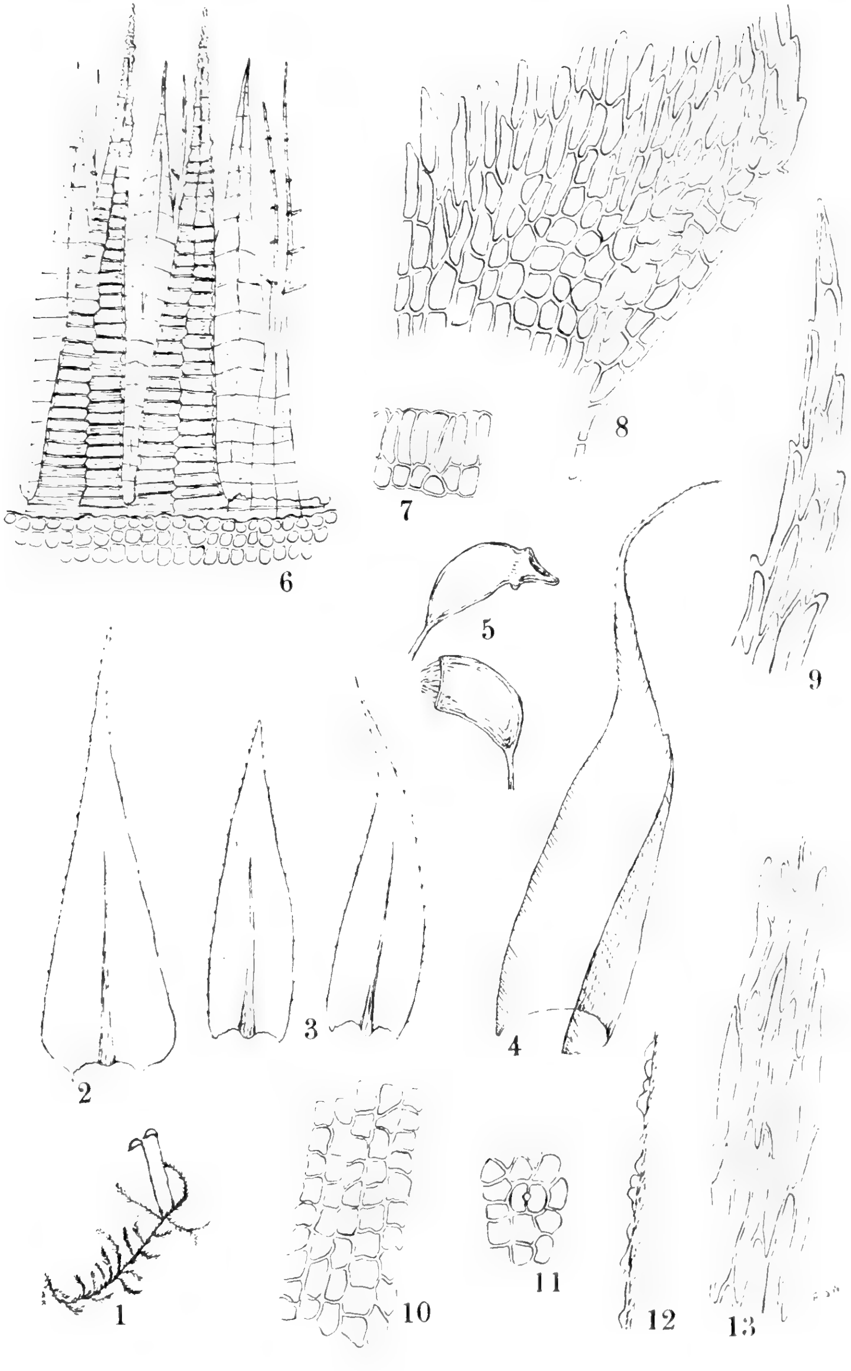
BRYUM SUBORBICULARE PHILIBERT.



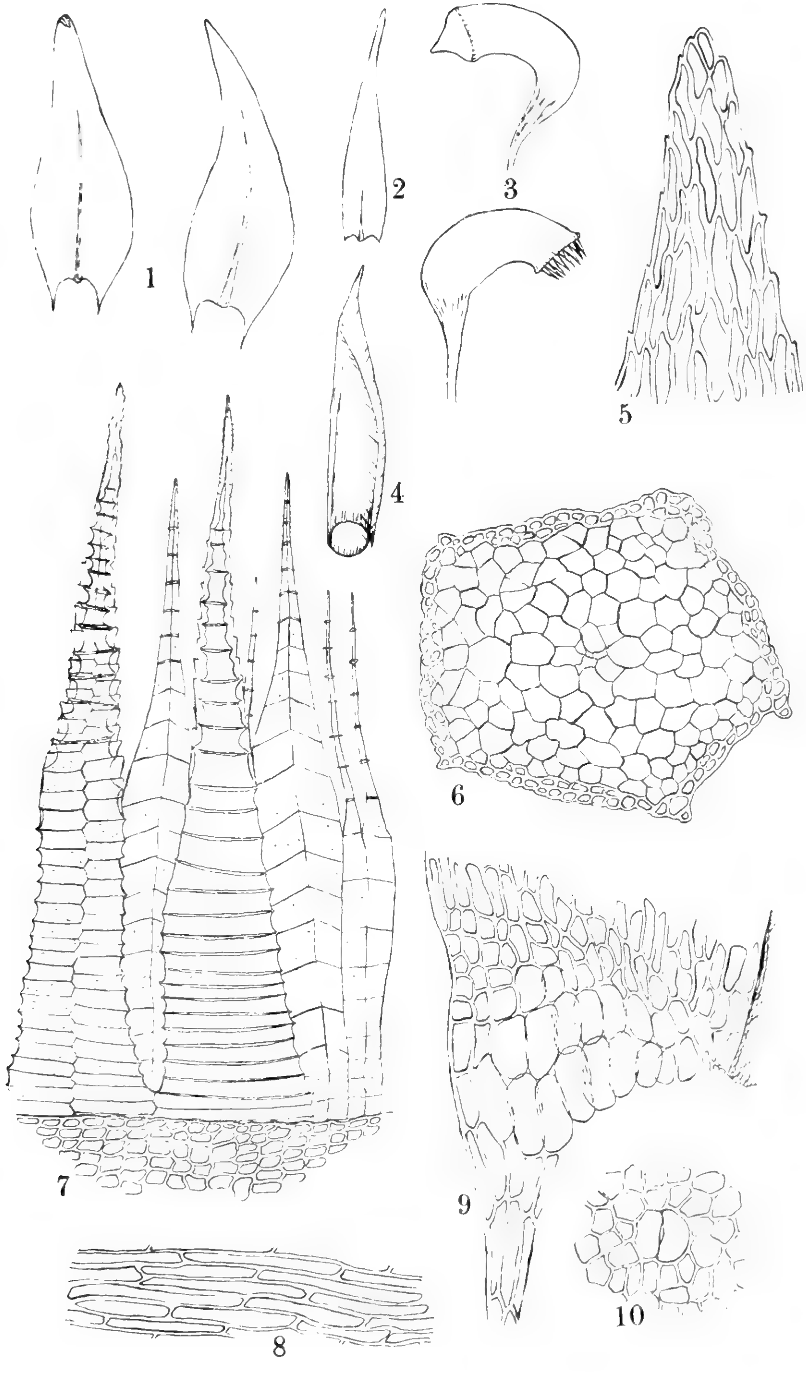
FIGS. 1–6. PLAGIOBRYUM ARGENTEOIDES R. S. WILLIAMS.
FIGS. 7, 8. PLAGIOBRYUM ZIERII (DICKS.) LINDB.



POLYTRICHUM INCONSTANS HAGEN.



BRACHYTHECIUM PETROPHILUM R. S. WILLIAMS.



HARPIDIUM AMBLYPHYLLUM R. S. WILLIAMS

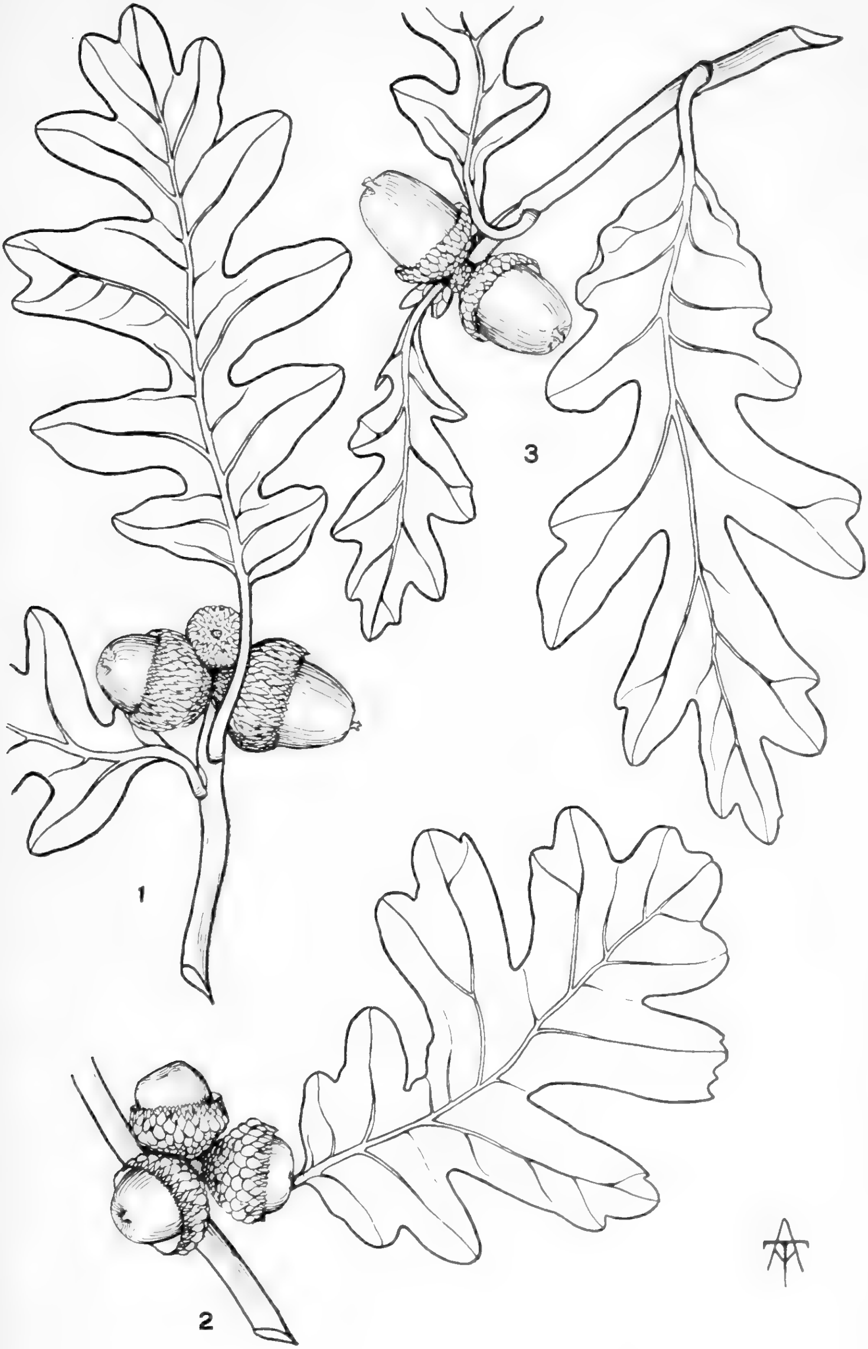


FIG. 1. QUERCUS SUBMOLLIS RYDB.
FIG. 2. QUERCUS UTAHENSIS (A. DC.) RYDB.
FIG. 3. QUERCUS VREELANDII RYDB.

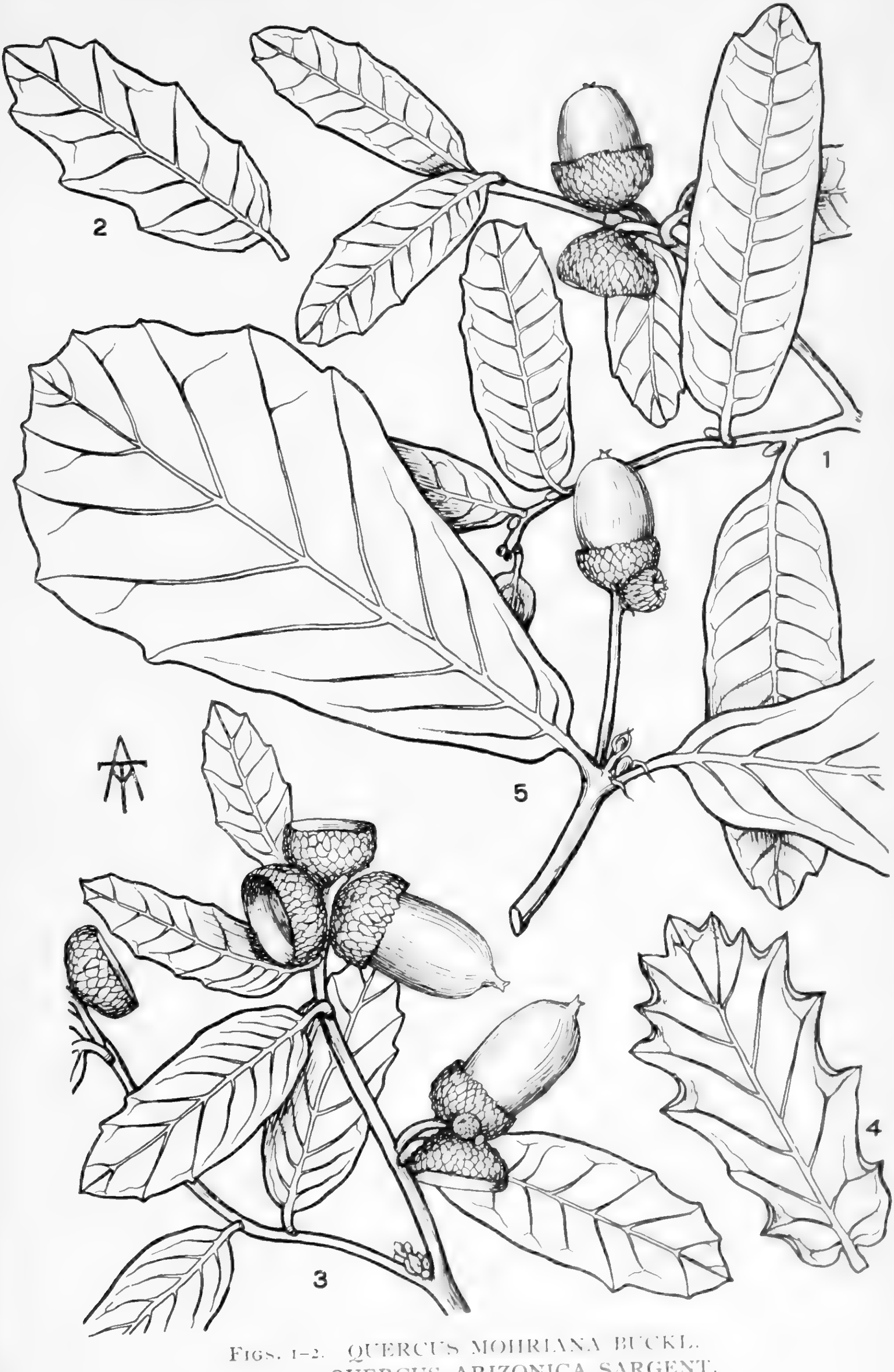
Figs. 1–2. QUERCUS LEPTOPHYLLA RYDB
Fig. 3. QUERCUS GUNNISONII (TORR.) RYDB.

FIG. 1. QUERCUS NITESCENS RYDB.
FIG. 2. QUERCUS NOVO-MEXICANA (A. DC.) RYDB.

Fig. 1. QUERCUS GAMBELII NUTT.
Fig. 2. QUERCUS EASTWOODIAE RYDB.
Fig. 3. QUERCUS VENUSTULA GREENE.

FIG. 1. QUERCUS FENDLERI LIEBM.
FIG. 2. QUERCUS HAVARDI RYDB.
FIGS. 3-4. QUERCUS OBTUSIFOLIA (A. DC.) RYDB

FIG. 1. QUERCUS BREVILOBA (TORR.) SARGENT.
FIG. 2. QUERCUS PAUCILOBA RYDB.
FIG. 3. QUERCUS PUNGENS LIEBM.
FIG. 4. QUERCUS UNDULATA TORR.
FIG. 5. QUERCUS UNDULATA VASEYANA (BUCKL.) RYDB.



Figs. 1–2. QUERCUS MOHRIANA BUCKL.
Figs. 3–4. QUERCUS ARIZONICA SARGENT.
Fig. 5. QUERCUS RETICULATA HUMB. & BONPL.

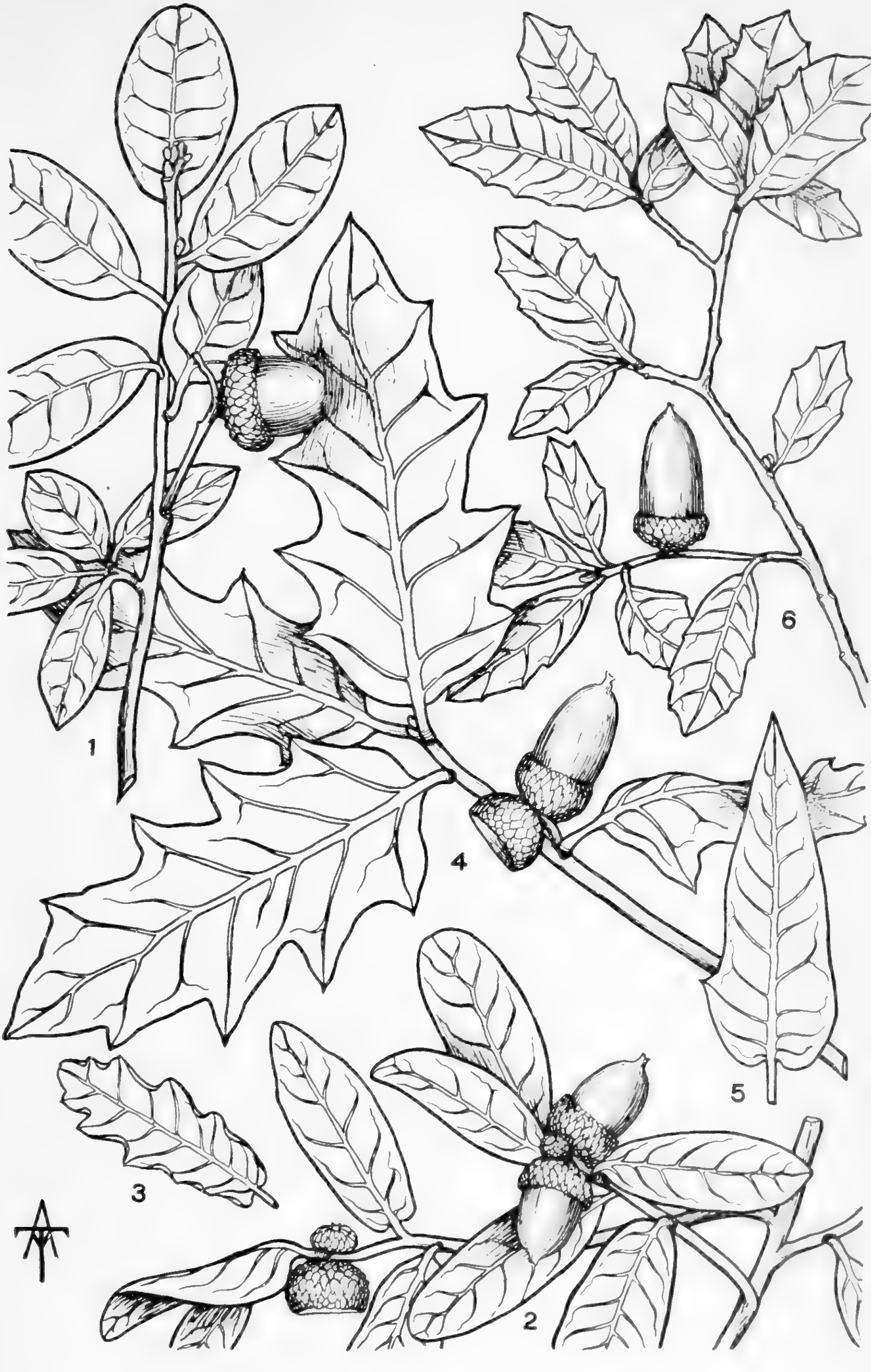


FIG. 1. QUERCUS GRISEA LIEBM.
FIGS. 2-3. QUERCUS OBLONGIFOLIA TORR.
FIGS. 4-5. QUERCUS EMORYI TORR.
FIG. 6. QUERCUS TOUMEYI SARGENT.

FIGS. 1-2. QUERCUS TURBINELLA GREENE.
FIGS. 3-4. QUERCUS WILCOXII RYDB.
FIGS. 5-6. QUERCUS HYPOLEUCA ENGELM

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Hon. Addison Brown,
Wm. L. Brown,
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VOL. 2. NO. 7.

BULLETIN

OF

THE NEW YORK BOTANICAL GARDEN.

[ISSUED APRIL 25, 1902.]

CONTENTS:

BULLETIN

OF

The New York Botanical Garden

Vol. 2. No. 7.

REPORT OF THE SECRETARY AND DIRECTOR-IN-CHIEF FOR THE YEAR 1901.

(*Submitted and ordered printed January 13, 1902.*)

TO THE BOARD OF MANAGERS OF THE NEW YORK BOTANICAL GARDEN,

Gentlemen: I have the honor to submit herewith my report as Secretary and Director-in-Chief for the year ending January 13, 1902.

The year has been one of great activity in construction, installation of exhibits, exploration, investigation and teaching. The number of visitors has been largely in excess of that in any previous year and the public interest in and acquaintance with the institution is steadily increasing.

Plants and Planting.

1. *Herbaceous Grounds.* Considerable rearrangement has been made of the herbaceous collections, by moving some of the groups from their previous positions to others nearby where the cultural conditions have proven by experience to be more favorable; this has been accomplished, however, without taking them out of the general botanical sequence. The addition of many species not hitherto represented, and the growth of others already installed, have necessitated taking considerably more ground under high cultivation. The

total number of species grown in this collection during the year is about 3020. Maintenance and installation have required the time of one gardener and two laborers during the cultural season. The excavation for the small lake, planned for water plants at the southern end of the herbaceous grounds was partly made during the fall and early winter, and may be completed in the spring.

2. *Fruticetum.* Little change has been effected in the collection of shrubs other than by the planting of additional species derived from various sources. This collection has now reached a condition, however, which makes it desirable to transplant, for cultural reasons, a considerable portion of it, and to thus bring the groups into areas more nearly in agreement with the plan to which we are working, than has been possible while the collection has been in a formative state; it is intended to effect this rearrangement in the spring. The number of species represented is 512. This collection has required the attention of one gardener and one laborer for about one-third of their time, but after its rearrangement, will probably demand their full time, during the cultural season.

3. *Salicetum.* The willow collection, established in the meadows and marshes near the northern end of the grounds has required little actual cultural attention; it has been somewhat increased by additional species drawn from the nurseries, the number now represented being 43.

4. *Arboretum.* The tree collections already planted have been cared for, but not materially increased during the year. A considerable number of specimens of deciduous trees have been moved into place east of the Bronx River, from the nurseries, but it has not been practicable as yet to extend the planting of conifers, this having to await the completion of grading operations in the vicinity of the conservatories, and it is unlikely that much of this planting can be done before the spring of 1903. In this connection I take pleasure in referring to the generous offer of Mr. Lowell M. Palmer, of Stamford, Connecticut, to present the Garden, from his very extensive collection of hardy conifers, with specimens of a

large number of species and varieties at such times as we are ready to receive them. Mr. Palmer's offer also includes specimens of many hardy ferns, of which he has a noteworthy collection. The total number of kinds of hardy trees represented in the Garden, including those native to the tract, is over 290. The care of the planted specimens has required the work of one gardener and one laborer for about one-third of their time.

5. *Viticetum.* The vines and trailers brought together on the rough arbor east of the Museum Building have been cultivated and trained, and many of them are now of considerable length. The number of species represented is 62. Their care has required the attention of a gardener for a few hours a week.

6. *Nurseries.* The plan relative to the nursery work referred to in my report for the preceding year was carried out in the spring, the first nursery planted being abandoned and its contents transferred to other plantations. The work was then concentrated on about two acres of land immediately south of the propagating houses on the east side of the grounds, part of this area being devoted to herbaceous plants, part to deciduous trees and shrubs, part to conifers; the cold frames were set immediately in front of the propagating houses. The work of propagation and experimentation both out of doors and under glass, is thus all brought together and is conducted by the same men; one foreman gardener, one apprentice and one laborer have been required, with a few days occasional additional help from a fourth man. The propagating houses are thus operated as a part of the nurseries. In addition to the care of several thousand young plants, cuttings and bulbs, brought into the nurseries from various sources, over 6,000 packets of seeds were sown; these were obtained by exchange from other botanical gardens, by gift, and collected by our several exploring parties. From this source we now have about 10,000 young plants for distribution during the next year among various permanent plantations, or for exchange with other institutions. The

number of species in the nurseries, not represented in other collections, is about 1,000.

7. *The Public Conservatory Collections.* The number of species growing in the great greenhouses has increased during the year through gifts, exchanges and the work of our expeditions from about 1,800 to 3,400; the collection naturally continuously occupies more space by growth, so that for these reasons the houses have now become fairly well filled, crowded, indeed, in some places; the additional houses now nearing completion are thus very welcome. The arrangement of the groups mentioned in my last annual report has been changed only in details. Many duplicates have been sent to other institutions, and many still remain available for exchanges. Some specimens received in bad order have been rejected, but, on the whole, our gardeners have succeeded wonderfully well in bringing such a necessarily heterogeneous collection into good condition. The operation of the new houses will now necessitate and permit an entire rearrangement of these collections; a detailed plan for this has been elaborated, taking into account the practically doubled variety of temperature and humidity conditions which the range will afford and which will enable better cultural results to be reached than has hitherto been possible for lack of such varied conditions. The care of the conservatory collections has been accomplished by a foreman gardener, seven gardeners and two apprentices; this force must ultimately be doubled.

The primary stocking of the conservatories was greatly aided by a special fund subscribed for this purpose in 1900 and 1901, as follows:

D. O. Mills	250.00
Samuel Henshaw	25.00
Charles F. Cox	50.00
N. L. Britton	100.00
J. Pierpont Morgan	100.00
Andrew Carnegie	250.00
Very Rev. E. A. Hoffman	50.00

S. P. Avery	50.00
John I. Kane	50.00
Wm. E. Dodge	250.00
Theo. F. Jackson	25.00
A Manager	100.00
A. G. Mills	10.00
Mrs. Esther Herrman	25.00
Banyer Clarkson	25.00
James B. Ford	200.00
H. C. von Post	100.00
Francis Lynde Stetson	25.00
James J. Goodwin	25.00
Samuel Thorne	50.00
Edgar L. Marston	25.00
Samuel P. Avery, Jr.	15.00
Samuel N. Hoyt	25.00
E. R. Holden	25.00
Isaac J. Greenwood	25.00
Anna R. Spring	10.00
Isaac N. Seligman	50.00
C. A. Coffin	50.00
Mrs. Edwin Parsons	10.00
W. S. Gurnee	50.00
Anonymous	10.00
Adolph G. Hupfel	25.00
Geo. Gill	10.00
Charles Pryer	10.00
Elizabeth Billings	15.00
John H. Bloodgood	20.00
	$2,135.00

This fund was mainly expended in paying transportation charges on plants secured by exchange with other institutions or donated by friends of the Garden, and in defraying the expenses of Mr. Geo. V. Nash, Head Gardener, during a visit to the Royal Gardens at Kew, England, in the early spring.

The stocking of the additional conservatories, now essentially completed, must be taken up as the most important

work of the year, as regards the collections, and one which will require the expenditure of a considerable amount of money.

8. *Boundary Borders.* The boundary borders have been cultivated throughout such parts as have been desirable, and variously modified by addition and substitution of plants. Most attention has been given to the western border, extending along the New York Central & Hudson River Railroad, from St. John's College to the north meadows, inasmuch as this boundary is permanently well defined by the railroad right-of-way. The mixed "old-fashioned" flower garden extending along the front of this border screen from the Southern Boulevard bridge north to the lakes has been maintained without much alteration, but it is planned to rearrange it somewhat in the spring. No work has been practicable along the St. John's College border, owing to road-building operations. The north border has been strengthened in places, but not much cultivated, and no work has been done on the east border, except in the vicinity of the stable. These planted borders now screen the grounds quite effectually from without along considerable portions of their extent. Their care has needed the work of one gardener and two laborers for about one-half their time.

9. *Other Plantations.* The groups of shrubs planted last year in the vicinity of the railroad station have been cultivated; an additional group was set out in the autumn on the right-hand side of the path from the station to the museum building, and the triangle formed by the intersection of the driveways south of the museum building was partly planted. Each of these groups has been formed of shrubs of the same natural family. A number of young trees were set out in the vicinity of the station in the spring; all this planting is in accordance with our general plan.

The total number of species now represented in the plantations, conservatories and including the native flora of the tract is about 9,300, an increase during the year of about 4,000.

The general direction of planting and of the care and recording of the plants, has been carried out by Mr. Geo. V.

Nash, head gardener, and Mr. Geo. A. Skene, second gardener, Mr. Nash taking personal charge of the administrative work, of the installation and the labeling, Mr. Skene superintending the cultural work and the care of the grounds, plantations, trees and forest. Labelling and recording has required the constant attention of two apprentices. Further details relative to plants and planting will be found in the report of the head gardener, hereto appended.

Buildings.

1. *Museum.* No changes have been found necessary in this building other than minor details of construction made desirable by the growth of the collections, and a few ordinary repairs. The installation during the summer in the east basement museum hall of the paleobotanical collections deposited with the Garden by Columbia College, under the supplementary agreement between the Garden and the Trustees of the College, dated May 3, 1901, made it desirable to construct two small rooms at the east end of the hall, for storage and sorting of the fossil plants. These were built during the autumn by means of brick partitions about one-half of the height of the hall. Cases partly sufficient for the display of this collection came with it from the college; these were set up and specimens arranged in them during the autumn; the miscellaneous specimens previously stored in this hall were removed to the basement room under the southern end of the east wing, and the paleobotanical collection was opened to the public early in December; it requires three additional table cases and eight additional wall cases to complete the furniture equipment of the hall. The new storage rooms are being fitted up with cases of trays built by our own carpenters.

In the west basement hall, used during the spring for horticultural exhibitions in coöperation with the Horticultural Society of New York, were placed four wooden tables, extending nearly the whole length of the hall; these are available for future use for the same purpose. The engin-

eers of the Park Department engaged in construction work on the grounds and buildings, previously accomodated in one of the east basement rooms, have recently been given temporary quarters by placing a movable partition in the western end of this west basement hall.

All the work of preparation, mounting and arranging museum and herbarium specimens, other than fossil plants, has now been brought into basement rooms at the east end of the building; the stock of back numbers of publications, now become quite bulky, but of great value for exchanges, has been stacked and arranged in another of the east basement rooms.

No new construction work has been done in the museums on either the first or second floor; both floors urgently require additional cases for the display of the constantly increasing collections, and it is hoped that these may be forthcoming during the year, through the additional appropriation for construction, asked by the Commissioner of Parks from the Board of Estimate and Apportionment on Nov. 25, 1901.

The silk shades placed in the upper parts of the windows of the second floor under the original contract for the construction of the building, have proven to be of poor material; they have faded and many of them have decayed. They are now being replaced by stout cambric shades.

Additional construction work on the third floor includes the building of a wall-case for the valuable collection of old microscopes presented by Mr. C. F. Cox, and of another for the collection of photographic negatives; these were made by our own carpenters, placed in the laboratories and their contents arranged for ready reference. Twelve table-desks for the laboratories built specially for the purpose, after a design by Dr. MacDougal were added to the equipment in May. The ordering of these was alluded to in my last annual report, as well as of additional shelves for the bookcases in the library stackroom, which were supplied in May. The desirability of shelving the walls of the library reading

room, also there referred to, became a need in the autumn, and on Oct. 23d the Board of Managers approved a design for this shelving, and authorized its construction; it was at once ordered, but has not yet been put into place. In order to permit the arrangement and ready access to duplicate books, the closet at the southern corner of the library stack-room was shelved by our carpenters to the ceiling, and the closet at the western corner of this room was fitted up with movable sets of shelves previously in use elsewhere. The herbarium of the Torrey Botanical Club presented by the Club to the Garden in June was arranged in old cases previously in use in the store-rooms, and placed against the wall in the hallway connecting the herbarium room with the taxonomic laboratory. A case for herbarium specimens under study was built at the eastern corner of the herbarium room, and another for the same purpose in the small store-room next the herbarium room.

The cases containing the main herbarium are now so nearly filled that the collection is being used under difficulties and with danger to the specimens themselves in handling. At least twenty additional cases are needed to accommodate the collection and its natural increase during the next two years; in case of delay in obtaining an additional city appropriation for construction, I propose to have eight such cases built by our carpenters during the winter.

The museum building has been open to the public every day in the year from ten o'clock until four-thirty or five; it has been found practicable to reduce the number of janitors from five to four men who have taken the entire care of it, including cleaning of floors, windows and cases. Public access to the building is still necessarily restricted to one of the basement doors pending the completion of the front approach, the contract for which has been vexatiously delayed to beyond the limits of satisfactory explanation. The main entrance cannot, for this reason, be used until spring.

The additional ornamental terra cotta work for the pavilions of the museum building, included in the contract refer-

red to, has likewise been delayed, and while recently delivered, cannot be put in position during the winter.

Front Approaches to the Museum Building. Under a contract awarded early in the year by the Commissioner of Parks to the Wilson and Baillie Manufacturing Company, work was begun in the spring, and was continued until stopped by cold weather in December. Reference to the part of this contract covering grading and road-building is made elsewhere in this report. The contract includes in addition, provision for the construction of a drinking fountain and marble seats on the south side of the driveway, a garden fountain with similar marble seats on the north side of the driveway, and the foundations, basins and copings for the statuary fountain immediately in front of the Museum Building; also the setting of the additional ornamental terra-cotta on the pavilions of the building itself. All this work is in accordance with plans drawn by the architect, Mr. Gibson, and duly approved by you and by the Commissioner of Parks. It has been exasperatingly delayed, and the contractors have long ago exhausted their time-limit under the contract; the foundations of all three fountains have been built and much of the marble has been set, but it will require at least a month's work in the spring to complete the contract, especially as some of the stone-setting has been found to be faulty and will have to be rebuilt; the terra-cotta has been delivered, but none of it put into place.

Under instructions from a subcommittee of the Executive Committee, Mr. H. A. MacNeil, sculptor, was invited in May to submit a model for the statuary fountain, the model previously submitted by Mr. Kemensky not having proved satisfactory. Mr. MacNeil has not yet sent his model in, but he has informed us that it is now essentially ready for examination.

2. *The Public Conservatories.* These buildings have stood the test of a year's operation satisfactorily. They have been open to the public every day from ten o'clock until four-thirty or five; breakage of glass from expansion

or contraction has gone on to a slight extent only, and has proved not nearly as great a charge for maintenance as it was supposed it would be. An unprotected blast of rock, just east of the eastern end, fired in August by a foreman in the employ of the contractor engaged in grading caused breakage which cost the contractor over $150 to repair; this is the only accident worth recording. The houses have been repainted throughout on the outside, and nearly throughout on the inside. A few minor defects in the roofs, causing leakage in heavy storms, have been mainly remedied, and I have recently accepted an unsolicited offer by Hitchings & Company, the builders of the roofs, to modify, at their own expense, the construction at the ridges of the lower houses, looking toward a complete correction of this defect, which has, however, not been of a serious character. The heating of these buildings has been easily accomplished by the radiating coils first installed, these having proven ample for the purpose in the coldest weather; from the exposed position of the houses this has, however, only been accomplished by the burning of a very large amount of coal. The trouble from gases emanating from the trenches alluded to in my last annual report has not again been experienced; it was apparently referable to volatile matter contained in the insulating covering of the steam mains.

After a series of observations with hygrometers and thermometers in all the houses taken at intervals of two hours from September, 1900, to May, 1901, in order to ascertain the desirable and practicable relations of temperature and humidity to establish for the different parts of the system in relation to the plant collections and to external light, a method of shading by a combination of stippling the inner surface of the glass, and by movable shades was adopted. It was necessary to devise this so as to make it practicable to extend it, without loss of work, to the additional houses, the construction of which was commenced at that time. The roofs and vertical sides of some of the houses were stippled, using a mixture of linseed oil and white-lead, determined for den-

sity after experiment; water-proof shades on spring rollers were placed in the roofs of two houses, and Japanese porch-screens were used for the vertical sides of the palm house and for the roofs of the succulent house. All this shading was done on the interior, leaving the outside of the building unmarred.

The results reached were very nearly those planned for, and hence satisfactory; the year's experience has naturally indicated some desirable modifications of details, which may be taken advantage of in the additional houses, as well as in those hitherto operated.

A contract for the construction of the additional houses to complete the range as originally planned was awarded by the Commissioner of Parks to John R. Sheehan & Company in May, and work was at once begun. These are now essentially completed and are under test for heating and leakage. Their internal fitting up with gravel and soil, and the spreading into them of the plant collections may soon be commenced, and they may be opened to the public in the spring.

The defect in the floor of house No. 4, mentioned in my last annual report, caused by sinking of filled ground, was repaired by the Sheehan Co., while building the walks in the new houses. Two painters and glaziers have been employed on the conservatories for nearly their whole time; it has been found possible, however, for them to do such painting and kalsomining as has been necessary at the other buildings.

3. *Power House.* The steam-heating apparatus has been adequate to heat both the public conservatories and the museum building, as planned, holding at least one boiler of the five always in reserve. During the summer an inspection was made of the entire system of pipes, in the subways and trenches; it was found necessary to rebuild some of the brickwork about the furnaces. The boilers have been regularly inspected. The incidental repairs required have been numerous but not excessive. The grading and road-building work east of the power house have given considerable trouble from storm-water which in two instances flooded the floor of the

building; this trouble cannot wholly be eliminated until the road-banks are sodded and the drainage properly disposed of, by connecting the system of land drains with the main city sewer in Webster Avenue, a work which is now in progress.

4. *Propagating Houses.* These small greenhouses were accepted by the Commissioner of Parks, from Hitchings & Co., the contractors, in January, and were at once turned over to us for operation. They have proved to be well built, easily heated and satisfactory for their purposes. The roof of the potting shed developed some leaks which have been repaired. Not having water under pressure at their location when they were finished a large brick tank was built between the two long houses as a roof-water reservoir, and this had to be depended upon until the water-pipe was laid to these houses during the spring. The plan for the propagating houses contemplates the building of a third long house in the future, but the need for it is not yet urgent.

5. *Stable.* No work has been done on this building except painting, reflooring stalls, and minor repairs.

6. *Public Comfort Station.* This building was connected with the sewer and the water-supply was brought to it during the summer, but, as other more important work prevented the building of paths to it, it has not been opened to the public, though useful for storage purposes.

7. *Tool House.* No changes have been made at this building.

Drainage and Sewerage.

In connection with the building of roads and paths about the public conservatories and of the front approaches to the museum building, the Department of Parks has laid earthenware drain-pipes of large size and constructed the necessary surface basins, substantially as contemplated in our plans. In the progress of path-building by our laborers, several additional surface basins have been constructed, and connected with the main drainage system, also according to plan.

The ultimate disposal of the drainage of the public conservatories and their surroundings west to the New York

Central & Hudson River Railroad, presented a difficult problem, and one which was not wholly solved in the general plan. It was finally determined to solve it in the most effective and permanent manner practicable, although entailing great expense, and thus necessarily delaying other work. At the time the tracks of the railroad were depressed and grade-crossings eliminated, the present bridge at the crossing of the Southern Boulevard was built and at the same time a brick sewer was laid under the railroad in the center of the Boulevard, but this had never been connected with the main city sewer in Webster Avenue to the west. I endeavored with the assistance of the Commissioner of Parks, early in the year, to induce the Department of Sewers to build this connection, in order that we might then connect with it on the eastern side of the railroad. This Department expressed entire willingness to do the work, and we hoped it might be arranged for, but it became apparent late in the autumn that funds were not available. Meanwhile the power house was endangered by storm-water, banks were being washed and the railroad right-of-way occasionally flooded. We then determined to use some funds available in a city appropriation for construction and in improving the grounds, and other money from your appropriation for grading, drainage and water supply, and do the work ourselves; it is still in progress. The essential difficulty is the necessity of making an open cut averaging 23 feet deep in filled ground full of boulders, but we have progressed up to the present time without incidents demanding record. This sewer connection, when once established, will take care of all the drainage and sewerage of the garden not already provided for or satisfactorily planned. A deep excavation for about fifty feet will be necessary at the eastern end of the Boulevard bridge, but the rest of the work will be simple. It is doubtless the most important piece of construction work now under way.

The plan for supplying the two lakes northeast of the museum building with rain water from the drainage system running south to the curve in the Southern Boulevard has

worked out satisfactorily, the watershed being sufficient to raise the lake surface about three inches for each inch of rainfall. This will be somewhat increased when all the grading is done and the surface basins all built. During long periods of drought it may be necessary to supplement this supply from the water mains, but not much additional water will be required at any time.

The dam in the Bronx River at the Lorillard mansion will ultimately have to be lowered as indicated by the original studies, in order to drain the northern end of the reservation in a satisfactory way; observation and experience during four seasons clearly show this to be necessary.

During the building of the driveways east of the Bronx River in the spring, the land drains previously laid about the stable and to the old nursery site were connected with a large earthenware pipe, which was laid northwest from near the stable to a point along the road north of the tool house, temporarily discharging on the surface at the head of a small valley; this line will ultimately be continued to the Bronx River. At the same time a sewer-pipe connection was made with the stable and the pipe laid northwest to a point which renders unnecessary the tearing up of the driveway in its continuation to the main sewer already built; this continuation may be built when convenient.

The roof water of the propagating houses is collected into a pipe which for the time being discharges on the surface at the east border of the park near the houses.

Water Supply.

Under the city contracts for construction the system of water-pipes has been much extended, in accordance with the general plans; a six-inch line has been laid alongside the park driveway built around the conservatories and connected at both ends with pipes of the same size previously laid; this has been supplied with hose-taps every 200 feet. Another six-inch line has been laid from a point on the Southern Boulevard east of the power house along the driveways to

the fountains on the driveway in front of the museum building and also supplied with hose-taps. A two-inch line was run from this to connect with pipes already laid to the railway station and the plantations about it. The large statuary fountain, now under construction, will be connected by a three-inch pipe with the six-inch line, which supplies the Museum; part of this has been laid.

Partly by means of city appropriation for construction and partly from our appropriation for grading, drainage and water supply, a six-inch line was laid from a point just south of the museum building along the driveway to the west lake; from here a two-inch line was run off across the park to the east along the driveways and under the Bronx River to the stable, nurseries and propagating houses, and another to the west along the lake to the public comfort station.

The City Department of Water Supply under permission granted them by you November 2, 1898, began in the spring the laying of a four-foot main through the grounds from a point on the western boundary northwest of the museum building, southerly in front of that building to the Southern Boulevard and thence on that road beyond the garden reservation; this line is a part of one of the primary distributing systems from the new Jerome Park Reservoir, and is designed to supply a large part of the eastern and central portions of the Borough of the Bronx. It runs through the Garden alongside of the old three-foot pipe from the Williamsbridge Reservoir. The work within the Garden was completed in November, with the exception of a few feet near the western boundary, where this main has to pass under the right-of-way of the New York Central & Hudson River Railroad; it appears to be unlikely that this will be finished until spring. A one-foot connection directly in front of the museum building has been left for the use of the Garden, when desired, in accordance with the terms of the permission given the Department. This connection with the new line, and the eight-inch connection we already have on the old one, ensure the park an abundant water-supply. Water will probably not be turned into the new main for two years or more.

Grading.

Grading operations outside the lines of road and building contracts have been continued by means of our teams and laborers throughout the year, as opportunity has been afforded, the new surfaces being made with topsoil ranging from one to four feet in thickness, obtained by stripping it from path and road lines, and from stacks previously made from the same sources.

The east side of the driveway built last year from the Southern Boulevard to the lakes was graded and sown or sodded; likewise the west side of this driveway from the museum to the lakes, and the sides of the paths parallel to this same driveway from the museum to the western lake, and from the museum for 800 feet toward the herbaceous grounds.

The slope between the east end of the museum building and this driveway, on which some work was done last year, has been completed and sown; a great deal of rock was encountered here, which was excavated to an average depth of four feet beneath the finished surface. Considerable work has been done in grading at the rear of the museum building, contingent upon the construction of the service road to the rear of that building, and the finished surfaces sown.

A large amount of filling, principally with top soil, has been done along the western side of the western of the two driveways to the front of the museum building; but the completion of this work has necessarily been deferred until spring, awaiting the finishing of these front approaches. Some top soil has been hauled from path stripping about the herbaceous grounds to the area south of the museum building and between it and the driveway, and stacked there ready for spreading.

The sides of the path, built along the western border of the herbaceous grounds have been graded and sodded or sown.

The total area regulated and graded and sodded or sown is over one acre.

The sides of the driveway built east of the Bronx River through the arboretum were graded sufficiently to make them safe, but no attempt was made to bring them to a final finish.

Under the Park Department contract with John B. Devlin, awarded Jan. 3d, 1901, referred to in my last annual report, for the grading and building of roads and paths about the public conservatories, much work has been accomplished, including the rough completion of the terrace about those buildings except at its eastern side and a portion of the northern; the approximately complete shaping of the grounds along the driveway and traffic road south and west of the conservatories, and its partial completion to the east and north of them, including partial reconstruction of the line of the Southern Boulevard. This work is still going forward; the provisions of this contract should be satisfied by June or July. Under a contract awarded in the spring by the Commissioner of Parks to the Wilson and Baillie Manufacturing Co., for the construction of the front approaches to the museum building, the unsightly hill south of that building has been removed, and part of the area brought to approximately finished grade; some rock excavation still remains to be done there in places and the top-soil stacked there in reserve must be spread. A very large rock surplus was obtained from the hill thus removed. Some of it was used at once in the Telford foundations of roads and paths and the rest stacked in the field in front of the museum building, and about the lakes, in order to have it convenient for future road and path building operations; it is being gradually used for these purposes and is of great value, although temporarily unsightly.

Roads and Paths.

The Park Department contract with John B. Devlin, awarded in November, 1899, referred to in my last annual report, for the building of driveways about the museum building, was completed in the spring. The greater portion of this work has stood very well, notwithstanding the heavy

wear to which it has necessarily been subjected by the subsequent cartage over it of building materials and soil; from this cause, and also on account of part of it having been surfaced and rolled in cold weather during the winter of 1900–1901, certain portions will need partial resurfacing; the contractor has agreed to do this at his own expense.

The Park Department contract with the John J. Hart Co., awarded in September, 1900, for building driveways from the lakes, eastward across the Park to the Bleecker Street entrance and to the Lorillard Mansion, and referred to in my last annual report, was also completed in the spring; the work has stood wear satisfactorily.

The Park Department contract with John B. Devlin, awarded December 11, 1900, which includes the building of driveways and paths about the conservatories, has been continuously prosecuted during the year, and, as mentioned under the heading of grading, is not yet completed. Under this contract, the service road, extending from the power house south and east along the St. John's College property, has been built essentially complete, but it has not yet been opened for public use, awaiting a final surfacing and rolling and some grading along its sides in the spring; the park driveway running parallel with this traffic road has also been nearly completed, needing yet to be connected at both ends with driveways previously constructed, and to be properly finally surfaced in warmer weather; part of the paths have been built, and the subgrade for other parts made, but most of the path work still remains to be done during the spring. Under the contract with the Wilson and Baillie Co., before referred to, the two driveway approaches to the front of the museum building have been nearly completed.

By means of our own teams and laborers, supplemented by a force kindly furnished by the Commissioner of Parks, the foundations of paths have been laid with surplus rock from the excavations for a total length of about 4,500 feet. This includes the line from the museum building to the western lake, a stretch at the eastern end of the east lake,

and one from near the museum building south to and nearly completely around the herbaceous grounds, all in accordance with the general plan. In the same way the Telford foundation has been laid up for the driveway extending north and east of the herbaceous grounds and thence south through the woods, skirting the western side of the Hemlock Grove, to the southern edge of the garden reservation, for about half its length (786 feet, 25 feet wide); stone for the continuation of this road is being hauled this winter from the surplus stacked in front of the museum building. It has been planned by the Park Department to continue this road from our southern boundary through the park land which separates the Garden from the Zoological Park, overlooking the Bronx River in places, to Pelham avenue, ending it on the avenue, opposite one of the entrances of the Zoological Park. When this is all carried out it will furnish a most useful and beautiful road connecting the two institutions. The surfacing of the paths and road built as above described will require a large quantity of broken trap rock and of trap rock screenings, but the principal expense of their construction has already been met by the building of their foundations from surplus stone, much of which was hauled to its place by the excavation contractors, who needed dumps at which to dispose of it.

The delivery road from the main driveway to the rear of the museum building, alluded to in my last annual report, has also been finished in the same way, except for final surfacing with trap screenings, and has been in use since midsummer. The cinder-surface road to the propagating houses on the east side of the grounds has been extended along the western side of the nurseries, but is not yet finished.

Local Telephone Service.

During the building of the subways and steam-pipe connections of the power house with the museum building and public conservatories in 1899 and 1900, telephone wires were laid, connecting these three buildings. During the past summer advantage was taken of the excavation for the water-pipes to the stable and propagating houses to lay

telephone wires for more than 4000 feet in the same trenches, to these buildings, which were thus all connected with each other. Naturally the system has proved very useful, and has made the need of messengers for local service unnecessary. The wires are underground throughout their entire extent; their location has been accurately plotted.

Further details of the construction work of all kinds will be found in the report of the Superintendent of Buildings and Grounds hereto appended. The work has been carried on with frequent consultations with the Hon. August Moebus, Commissioner of Parks, his Engineer-in-Chief, Hon. Martin Schenck, his Chief Clerk, Mr. Gunther K. Ackerman, and the Superintendent of Parks, Mr. Peter Gecks, and I desire to express my appreciation of the interest and coöperation of these gentlemen.

The great amount and varied character of construction under way has necessarily put large portions of the grounds into an apparently chaotic condition, but the most difficult and expensive work of building both garden and park will be accomplished by the end of the present year, if the additional appropriation of $150,000.00, asked for by the Commissioner of Parks in November is voted before Spring. Comparatively small construction appropriations only will subsequently be required to complete the carrying out of the plans, and most of the area can be rapidly brought into essentially permanent condition.

Care of the Grounds.

No damage worthy of remark has been done by visitors; the notices forbidding the picking of flowers or breaking of branches from plants either wild or cultivated have been respected and no arrests for depredations of any kind have been made. Some of the employees have been on guard every Sunday and holiday, largely as a precaution against the spread of fires, particular attention having been given to the hemlock forest. The drought of 1900 was destructive to trees all over the northeastern United States, and the woods in the Garden shared in its effects, it having been

found necessary during the winter of 1900–1901 to remove many dead trees, although not enough to be missed; on the contrary, very few trees died during the past year, and these have already mainly been removed. Picnicing in the woods has continued, and has not been restricted except in cases where a large number of people wished to congregate; it has therefore been necessary, during the summer and autumn to detail a boy to the work of collecting paper and other rubbish scattered by visitors. Official permits for picnicing have not been given, however.

The forests may be much more certainly and easily preserved after the system of walks and drives planned have been built through them; the greater number of pedestrians will naturally follow the paths, and may be directed to do so when it becomes necessary. The paths and roads at present under construction or already built will serve to lead to the forests at several points at which their extension into and through the forests may next be taken up. It will be preferable to build the forest drives and paths by day laborers under our immediate supervision than under contracts.

The cleaning and watering of the driveways already built have been done by employees of the Park Department.

The lawns and banks have been rolled and mowed by horse and hand mowers and the surface drainage basins have been inspected and cleaned out when necessary.

The grass on the arboretum tract and other undeveloped areas has been cut for hay and stacked in barracks near the stable, more being harvested than needed for our horses; a second barrack, like the one described in my last annual report, was built during the summer.

Library.

As appears from the report of the Librarian, hereto appended, the library has been increased during the year by 2,482 volumes besides several thousand pamphlets and parts, the total number of bound volumes being now 11,314. Gifts of books have been numerous and very welcome; they have

been duly recorded in the JOURNAL. Gifts of money applied to the purchase of books, and credited to the special book fund have been made as follows:

W. C. Schermerhorn	$ 500.00
Mrs. Alfred Corning Clark	100.00
Andrew Fletcher	25.00
D. O. Mills	500.00
J. Pierpont Morgan	500.00
Miss Olivia E. Phelps Stokes	100.00
Miss Caroline Phelps Stokes	100.00
	$1,825.00

The number of books bound during the year is 973. The number of catalogue cards written was over 5,000.

Additional exchanges of publications have been arranged, the number of journals, periodicals and reports now received by us for our own publications being 207.

Under the supplementary agreement with the Trustees of Columbia College dated May 3d, 1901, the paleobotanical portion of the College library was deposited with the Garden during the summer, and after a critical comparison of it with the shelf-lists of the College library, I signed a receipt for the books as well as for the fossil plants from the College geological museum, under the provisions of the supplementary agreement.

An agreement was made with the Torrey Botanical Club, whereby all books and pamphlets received by the Club in exchange for its publications now become the property of the Garden, the Garden on its part granting the members of the Club the privileges of its library; by this agreement we receive regularly 31 serials, in addition to those brought in by our own publications.

Museums and Herbarium.

The public museum collections have been largely increased by gifts, exchanges, purchase, and by the results of our expeditions. These have been duly reported in the JOURNAL. It has been sought to put the additional specimens into place in the cases, so far as space would permit, as soon as they

could be properly mounted, rather than to permit them to accumulate awaiting proper labelling. The labelling has gone forward as rapidly as possible coincident with accuracy, and at the present time comparatively few specimens in any of the public collections remain unsupplied with labels. A commencement has been made on a scheme to cross reference museum specimens to the living plants which yield them, but this valuable educational feature can not yet be worked out very effectively owing to the formative condition of both museum collections and the collections of living plants.

The collection of fossil plants deposited with the Garden by the Trustees of Columbia College, under the supplementary agreement between the two institutions dated May 3d, 1901, was set up in the east basement museum hall during the autumn. It consists of about 8,000 specimens, comparatively few of which can yet be displayed for lack of cases. This addition of paleobotany to the subjects under the purview of the Garden, materially strengthens our educational tender to the public and to students and investigators. The Columbia College collection is extensive enough to illustrate the development of vegetable life on the earth from the most ancient geological time when plants are known to have existed, to the present, not without very many gaps, however, which it should be our endeaver to fill as opportunity offers. The placing of the collection with the Garden was arranged upon the suggestion of the College authorities, which was cordially received by us, experience having shown that research in paleobotany can better be prosecuted in connection with the science of botany than with geology, besides affording the public an insight to the fascinating problems involved, through the agency of a museum open at all times.

The identification of the college specimens by means of a painted symbol as provided for in the agreement above referred to, is going forward, in order to keep them readily distinguishable from specimens the property of the Garden, the accumulation of which has already been commenced in coöperation with the Geological Survey of Maryland and from other sources.

The number of specimens received from all sources for the museums and herbarium during the year, in addition to the fossil plants aggregates 61,614; the number permanently incorporated into the several collections is over 79,000; thus nearly 18,000 specimens previously received have been mounted; these then represent the gain made in the sorting and arrangement of specimens carried over from last year in the store rooms. A vast number still remain unstudied, but the gain is encouraging, and work is now so organized that we expect to be able to very materially reduce the unsorted material during 1902. Ten museum aids have assisted the curators in the work, who have also been aided by students and other investigators.

Through an agreement with the Torrey Botanical Club, the herbarium accumulated by that society was presented to the Garden in the spring. It consists wholly of specimens of plants growing naturally within one hundred miles of New York City, and is a valuable collection on which to build a complete illustration of the local flora. It serves a very useful purpose by saving the main herbarium from the use of local students, and answers their inquiries more rapidly and in many cases more satisfactorily than by reference to the general herbarium.

Contributions of money for the purchase of collections and credited to museum and herbarium fund have been made as follows:

Andrew Carnegie	$ 500.00
Samuel Sloan	100.00
Samuel D. Babcock	250.00
G. S. Bowdoin	200.00
Addison Brown	100.00
D. O. Mills	200.00
Edward D. Adams	100.00
Geo. B. Hopkins	50.00
Francis Lynde Stetson	50.00
Mrs. Esther Herrman	100.00
Dr. Henry F. Walker	50.00
H. C. von Post	100.00
	$1,800.00

The contribution of Mr. Carnegie was used for the purchase of the collection of Mr. A. Vigener, of Wiesbaden, Germany, rich in rare Mexican species and in plants of central and northern Europe, including valuable series of seaweeds, lichens and fungi. The contributions of Messrs. Sloan, Babcock, Bowdoin, Brown, Mills, Adams, Hopkins and Stetson were used in securing a set of the famous collections of Chinese and Formosan specimens, nearly 8,000 in all, accumulated by Dr. A. Henry, during several years of exploration; this gives us the best collection of specimens of Chinese plants in America; a somewhat more complete set of Dr. Henry's plants has become the property of the Royal Gardens, Kew, England. The contributions of Mrs. Herrman and Messrs. Walker and von Post have been applied towards purchasing the collection of Prof. F. S. Earle, recently appointed an assistant curator of the Garden; about $400 additional is needed to make this purchase complete. The collection is of high scientific value, containing several thousand specimens of fungi, including many type specimens, a nearly complete representation of the flora of the State of Alabama, and much material from various localities; it is hoped that means may soon be found to complete its purchase. Additional data concerning work on the museums will be found in the report of the Curator hereto appended.

Laboratories.

The laboratories supply ample and convenient space for the investigations carried on by members of the staff and by students. Their equipment with furniture and apparatus has gone forward by meeting actual necessities as they have arisen. Here, as in many other parts of the museum building, in constant use, the need of additional cases is great. As shown by the appended report of the Director of the Laboratories, twenty-seven students have carried on work during the year under the guidance of members of the scientific staff. Each of these students has been assigned, or has chosen, a special subject for investigation, and many results of scientific

or immediate practical value have been reached; some of these have been published; others await publication. Many students of the two preceding years have honorable positions as teachers or investigators in other institutions. It is proposed to keep a record of the work of students subsequent to their attendance at the Garden, in so far as this can be obtained—a kind of alumni list. We have been unable to supply students to fill some positions that have been brought to our attention during the year. Dr. Marshall Avery Howe, appointed an assistant curator in July, 1901, has been detailed to aid Dr. MacDougal in the charge of the laboratories during part of his time.

Lectures.

A course of public lectures delivered on Saturday afternoons in the lecture hall of the Museum Building, was commenced on April 6th and continued until June 29th; another course commenced October 12th and closed November 16th. These lectures were attended by appreciative audiences. All members of the Garden were notified of the lectures by tickets, and they were at the same time especially invited to visit the Garden under escort by members of the staff. A large number of members took advantage of these invitations and have thus kept in touch with the development of the institution. The lecture courses have been duly recorded in the JOURNAL.

Publications.

BULLETIN 6, commencing the second volume, was issued May 27, 1901, containing the reports of officers and committees for the year 1900, and botanical contributions written by members of the staff.

The JOURNAL has been issued monthly throughout the year, under the editorship of Dr. MacDougal, and has served to inform our members and the public of the progress of development of the institution; under authority given by the Scientific Directors, it is proposed to increase its size somewhat, during the coming year. Nine contributions, written by students and members of the staff, have been reprinted

from the *Bulletin of the Torrey Botanical Club*, in which they were first published, the total number of such contributions being now nineteen.

All our publications have been in demand from other institutions and students all over the world, and their distribution has brought us exchanges of books and specimens, in value greatly in excess of the cost of publication.

Exploration.

A very large number of living plants, and of specimens for the museums and herbarium have been obtained by members of the staff detailed for exploring regions little known botanically, and for visiting other institutions. The expenses of this work have been defrayed in part by appropriations from the general fund, and in part by contributions of money from members of the Garden as follows:

Wm. E. Dodge	$ 600.00
Samuel Thorne	100.00
Geo. W. Perkins	250.00
Richard H. Allen	100.00
James B. Ford	100.00
Very Rev. E. A. Hoffman	100.00
Roland G. Mitchell	100.00
Adrian Iselin	200.00
Isaac Seligman	100.00
Robert M. Thompson	100.00
N. L. Britton	100.00
F. N. Warburg	100.00
Geo. Foster Peabody	100.00
	$2,050.00

Detailed accounts of the exploration work have been published in the JOURNAL. It is mainly by exploration and by visits to other institutions for arranging exchanges that the collections of the Garden may now best be built up. Much desirable material can yet naturally be obtained by purchase, but that of the greatest scientific and educational value must be collected; trained collectors are almost necessary for this

purpose, and our own staff supplies the best, for they know what we already have and what we lack. A special Exploration Fund could now be operated with immense advantage to the Garden and to the progress of science.

Investigations.

The development and organization of the facilities of the laboratories, the accession of a large number of books and periodicals to the library, and the additions to the collections of living, preserved and fossil plants has resulted in a direct and marked increase in the efficiency of the Garden in carrying out one of its most important functions in the promotion of research.

Not only have the advantages in the several subdivisions of the subject to which attention has been previously directed, been increased, but the appointment of additional members of the staff, and the removal of the paleobotanical collection of Columbia University to the Garden have given additional opportunities for the consideration of problems in economic botany, plant pathology, developmental taxonomy, and paleobotany. The results of some of the investigations completed have been brought out in the publications of the Garden, or in other periodicals, and others are still in press.

Professor L. M. Underwood, of Columbia University, has continued his studies of the ferns and fern allies, and carried out field observations on the flora of Porto Rico and Colorado. Professor Underwood has also exercised supervision over the work of the Columbia students at work in the Garden.

Dr. H. H. Rusby, curator of the economic collections, has continued his investigations of the flora of Colombia and Bolivia, and also given much attention to various economic problems.

Dr. D. T. MacDougal, first assistant, has completed his studies in experimental morphology of *Lysimachia*, and published a manual of Plant Physiology containing an outline of the principles of the subject, and such detailed methods of

experimentation as to make it an aid to research. He has carried on field work in Montana and Nebraska, making studies of the xerophytic and alpine floras and of geographical distribution. Dr. MacDougal has brought his investigations on the relations of light to growth and development into a form suitable for publication, and has directed the operations of the laboratories.

Dr. J. K. Small, curator of the museums, has carried forward his work on the flora of the southeastern United States, and made critical studies of a large number of genera occurring in this region. Some field work was done in southern Florida in connection with these studies. The preparation of his manual of the flora of this region has been carried steadily forward and more than half of it has already been printed.

Dr. P. A. Rydberg, assistant curator, has continued his work on the flora of the Rocky Mountains and made critical studies of *Quercus*, *Limnorchis*, *Piperia* and the Potentilleae.

Mr. F. S. Earle, assistant curator, has devoted considerable attention to the determination of collections of fungi from Porto Rico, Florida, Colorado, Wyoming and California, and made some critical studies of the Sphaeriales, Hysteriales and Agaricaceae.

Dr. M. A. Howe, assistant curator, has been engaged in a general systematic study of the marine algae, upon which he has made extensive field observations in Newfoundland and Nova Scotia.

Dr. A. Hollick, assistant curator, has made special studies of the fossil flora of Long Island, and field observations on flora of the sand dunes of Cape Cod, on the fossil flora of Chappaquidick Island and of the Pleistocene flora of the Chesapeake Bay region.

Mr. G. V. Nash, head gardener, has continued his studies of the American grasses, and of cultivated plants, making visits to the Royal Gardens at Kew, and to the southern part of Florida for the purpose of extending the range of his work.

Miss A. M. Vail, librarian, has continued her studies of the Asclepiadaceae.

Mrs. N. L. Britton, voluntary assistant, has continued her studies on the mosses of North America, and in conjunction with Miss A. Taylor made exhaustive morphological examinations of *Schizaea pusilla* and *Vittaria lineata*. The results of the investigations upon the first-named plant have appeared in the contributions of the Garden and the second is in press.

Professor F. E. Lloyd, of Teachers College, has made some morphological studies on *Chrysoma* and *Pteridium* and published the results of his survey of the coast and islands of the Mississippi Sound. His studies on the embryology of the Rubiaceae have been brought to completion and are now in press.

Professor E. S. Burgess, of the Normal College, has completed his historical and bibliographical researches on the *Asters*, and made a systematic arrangement of the numerous species in this group in conformity with the results of his studies. The results of this work are now in press.

Dr. C. C. Curtis, of Columbia University, has carried out extensive experiments dealing with the movements and pressures of fluids in plants, and has not yet brought his work to completion.

Dr. Alex. P. Anderson, of Columbia University, has brought to a close his investigations of *Dasyscypha resinaria*, a fungus parasitic on *Abies balsamea*, carried forward his researches upon growth and upon various economic problems.

Miss Alexandrina Taylor, museum aid, carried out a morphological examination of *Schizaea pusilla* and *Vittaria lineata* in conjunction with Mrs. N. L. Britton, and the results have been partly published, as noted above.

Mr. R. S. Williams, museum aid, has made marked progress in his study of the mosses of Montana, in addition to describing several new species from other parts of North America. He has carried out extensive field work in Bolivia, in which he is still engaged.

Mr. S. H. Burnham, museum aid, has devoted considerable attention to a systematic arrangement of the flora of the Champlain valley.

Mr. J. E. Kirkwood, of Syracuse University, has carried forward his studies in the embryology of the Cucurbitaceae, which will not be completed for some time.

Miss V. S. White has completed her work upon the Tylostomataceae and the results have appeared as a contribution from the Garden. Her studies upon the Nidulariaceae have also been brought to a close and the results are now in press. Similar work by her upon the Lycoperdaceae is going forward.

Mr. R. M. Harper has continued his work upon the geographical distribution of the flora of Georgia and made critical studies of some of the genera represented.

Miss Elsie Kupfer has made a complete systematic and morphological study of *Geopyxis* and *Urnula*, and made an examination of some defective cocoanuts. The results of both pieces of work have been published and the article upon the latter subject has been republished by the government of Jamaica.

Mr. John R. Gardner has made a classification of the Celastraceae of North America in accordance with the results of his examination of the group.

Mr. W. A. Cannon has begun an extensive series of experimental observations and morphological studies upon hybrids, which will need some time for completion.

Miss R. J. Rennert has completed her morphological and physiological investigations upon the seedlings of *Arisaema* and the results will appear as a contribution from the Garden.

Miss Julia T. Emerson has taken up an experimental cultural study of the *Fusarium* parasitic on the rose.

My own attention has been given to the further study of the flora of Porto Rico and other West Indian islands; field observations and a study of the geographical distribution of the plants of St. Kitts have been made, in addition to the critical study of various groups of North American plants. My work upon the systematic arrangement of the flora of northeastern America has resulted in the publication of a manual dealing with the plants of the Northern States

and Canada, in which numerous new species have been described and new systematic arrangements established. Attention has also been given to the guidance of the research work of various students and members of the staff.

Reports Appended.

I submit, also, reports by the Curator of the Museums and Herbarium, the Curator of the Economic Collections, the Director of the Laboratories, the Librarian, the Head Gardener, the Superintendent of Buildings and Grounds, and a Schedule of Expenditures under appropriations by the Board of Managers.

Respectfully submitted,

N. L. Britton,

Director-in-Chief.

REPORT OF THE CURATOR OF THE MUSEUMS AND HERBARIUM.

To the Director-in-Chief.

Sir: I have the honor to submit herewith my report as Curator of the Museums and Herbarium for the year 1901:

1. General Accessions. Specimens amounting to a total of 61,614 have been added to the various collections. About 79,102 specimens have been incorporated in the permanent collections of the museums and herbarium. We are storing many thousand specimens, awaiting an opportunity to incorporate them into the collections, while a great deal of material not needed for the permanent collections has been placed in our duplicate series, and has been exchanged with other institutions for desirable specimens. These accessions have been obtained as follows:

(*a*) *Gifts and Purchases.* Friends of the institution have presented either individual specimens or collections, or they have furnished the funds for the purchase of desirable collections in addition to the annual appropriation made for this purpose by the Board of Managers.

(*b*) *Exploration.* The rapidly growing system of exploration, which led to the placing, during the year, of exploring parties in various parts of North America, northern South America, the West Indies and southern Asia, has added a large amount of desirable, rare and unique material to our collections.

(*c*) *Exchanges.* In addition to exchanges with individuals others have been maintained with the following institutions:

United States National Museum.
Royal Botanical Garden, Kew, England.
Biltmore Herbarium.
University of Nebraska.
Catholic University of America.
Field Columbian Museum.

Geological Survey of Canada.
Montana College of Agriculture.
Philadelphia Museums.
Harvard University.
Royal Botanic Garden, Berlin, Germany.
American Museum of Natural History.
Delessert Herbarium, Geneva, Switzerland.
Boissier Herbarium, Chambésy, Switzerland.
University of Wyoming.
Lafayette College.
University of Minnesota.
Royal Botanic Garden, Edinburgh, Scotland.
University of Montana.
University of Idaho.
Royal Botanical Garden, St. Petersburg, Russia.
Buffalo Botanical Garden.
Washington State Agricultural College.
Botanical Garden, Brussels, Belgium.
Botanical Garden, Zurich, Switzerland.
Botanical Institute, Montpellier, France.

Museums.

Accessions.*—During the year, 1,445 specimens were received for the museums. Most of these specimens will ultimately be placed in the public collections. It is a pleasure to note that a great portion of this material came to us as unsolicited gifts, a condition that shows the lively interest taken in the institution by the manufacturers, the importers and the general public.

2. Preparation of Material for Exhibition.—The appliances for exhibiting specimens mentioned in the following paragraphs are only such as form a part of the permanent equipment of the museums. The equipments for collecting and storage and all appliances used in a temporary way are not here considered.

* For a detailed list of accessions, see Journal of the New York Botanical Garden, **2** : nos. 1–12.

(*a*) *Exhibition blocks*, as described in Number 5 of this BULLETIN, were secured in the following sizes and quantities, ebonized and placed in the exhibition cases:

Width.	Length.	Number of Blocks.
4¾ inches.	4¾ inches.	100
4½ "	5½ "	300
4¾ "	8 "	100
6 "	12 "	50
	Total,	550

(*b*) *Glass jars*. (Specimen jar, 2,605, Whitall, Tatum & Co.)

Diameter.	Height.	Number of Jars.
2½ inches.	7 inches.	36
3 "	8 "	48
3¾ "	10 "	72
4½ "	12 "	192
6 "	18 "	72
	Total,	420

(*c*) *Exhibition cards*, as described in Number 5 of this BULLETIN:

Size of Cards.	Number of Cards.
7 x 11 inches.	24
11 x 11 "	24
11 x 14 "	24
14 x 22 "	24
Total,	96

(*d*) *Oak frames for displaying specimens mounted on cards:*

Size of Frames.	Number of Frames.
5½ x 14 inches.	125
6 x 14 "	125
6½ x 14 "	125
9½ x 12½ "	12
11 x 11 "	150
12 x 14 "	189
14 x 22 "	370
Total,	1,096

In addition to the frames, five hundred feet of the oak moulding from which the frames are made was secured. From this supply we made frames of odd sizes as occasion demanded.

3. INSTALLATION. Our work in connection with the installation was mainly a continuation of that of the latter part of last year, as outlined in my last annual report. The general disposition of the various exhibits has not been materially altered. New exhibits have been installed, while numerous individual specimens have been incorporated into the exhibits already installed, in order to fill existing gaps or for the purpose of fuller illustration.

4. LABELLING.—The permanent labelling of the collections has been continued as fast as our printing outfit would permit. Many of the exhibits, which could not be furnished with our standard label, have been supplied with temporary labels.

5. ECONOMIC MUSEUM.*—The plan originally adopted for this museum has been followed without noteworthy change. Additions have been made to nearly all the exhibits installed during last year. The exhibits of fibers, foods, drugs, oils, gums, resins, starches and sugars have been considerably increased. We have been forced to store considerable valuable and interesting material on account of the insufficient equipment of cases.

6. SYSTEMATIC MUSEUM. As in the case of the Economic Museum, the general plan of this Museum remains the same as it was last year.

(*a*) *The Synoptic Collection.*† Considerable attention was devoted to this collection both in the matter of filling up gaps in the sequence of the plant families and in furnishing the specimens with exhibition blocks and frames. The collection as it now stands is almost completely framed, while many specimens are awaiting installation for need of glass jars.

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* For details see Report of the Curator of the Economic Collections.

† For further notes on this collection see Journal of the New York Botanical Garden, 2: 81.

(*b*) *Local Flora.* This collection has proved to be much more popular than we at first anticipated. During the year all the large plant-groups, with the exception of the Algae and Fungi, have been mounted and the greater portion of the collection, consisting of the ferns, fern-allies and flowering plants, has been renovated and completely labeled. About seven more stands similar to those now in use are needed for the algae and the fungi.

(*c*) *Microscopic Exhibit.* The popularity of this exhibit has continued as heretofore. Experiments on several anticipated additions, and corrections of some of the original details have been made.

7. FOSSIL PLANT MUSEUM. During the summer the paleobotanical collections of Columbia University were brought to the Garden and deposited in the east exhibition hall of the basement of the museum building. Work designed to accomplish a temporary installation was at once begun and about the middle of December the hall was thrown open to the public. The case equipment is inadequate, and relatively few of the specimens can be displayed. There are many valuable specimens still in boxes and the bulk of the material is yet unsorted. In order to get rid of all boxed material, a rack of sorting drawers is now being constructed and in a short time the whole fossil collection will be accessible, at least for study and teaching purposes. The estimated number of specimens in this collection is about 8,000.

8. CARE OF THE COLLECTIONS. The usual amount of readjustment of exhibits and the replacing of inferior specimens with better or more illustrative ones, has been continued. Both the newly received specimens and such of those already installed that require it, have been poisoned with mercuric chloride, chloroform or carbon bisulphide in order to insure good preservation. Considerable attention has been devoted to keeping the specimens fresh in appearance; much of the dry material preserved in jars soon soils the inside surface of the glass so that once or twice during the year it is necessary

to clean the jars and readjust the specimens. Considerable discoloration takes place in the collections preserved in fluid, so that decanting and substituting clear fluid is necessary. All specimens preserved in formaldehyde solution have been carefully watched and once or twice during the year small quantities of formaldehyde have been added to each jar in order to guard against a possible deterioration of the strength and preserving properties of the solution.

9. USES OF THE MUSEUMS. The museums have constantly been used in connection with the teaching work of the Garden and have been made use of from a similar standpoint by many individual students and by schools from New York City and neighboring states. As far as I have personally observed and have been informed, the visiting public has taken more than passing interest in the collections. Importers and manufactures have consulted the collections for information of a special nature and many of them have repaid the institution for the information thus gained by donating specimens.

Herbaria.

1. GENERAL ACCESSIONS.* Specimens from numerous sources, amounting to a total of 60,169 were added to the collections during the year. All the specimens not needed for the permanent collections are being placed in the duplicate series, or exchanged for desirable material with other institutions.

2. MOUNTING AND CONSERVING OF HERBARIUM MATERIAL. The herbaria have been increased by about 55,747 sheets during the year. On these sheets fully 77,657 specimens have been mounted.

A great amount of the material obtained through gifts and purchases that has necessarily accumulated during the past few years, chiefly on account of inadequate quarters and means, has been mounted, and incorporated into the permanent collections, thus making accessible for study much valu-

* For detailed list of accessions, see Journal of the New York Botanical Garden, 1 : nos. 1–12.

able herbarium material and considerably reducing the still partially inaccessible portion.

All specimens subject to the attacks of insects, that now find their way into the permanent collections, are thoroughly poisoned with an alcoholic solution of mercuric chloride. Experience has demonstrated that this is the safest and most economical way of preserving the specimens.

3. Disposition of Bulky Herbarium Material. During the past few months it has been possible to take the preliminary steps toward the final arrangement of this important part of the collections. A system of multiple-size boxes has been adopted for containing all specimens that cannot be mounted on the regular herbarium sheets, such as fruits and seeds or other bulky parts of plants, that are not required for the public museum series. Accordingly durable pasteboard boxes of the following sizes have been added to the herbarium equipment:

Dimensions of boxes.	Number of boxes.
1¼ x 2¾ x 4 inches.	2,000
2½ x 2¾ x 4 "	400
1¼ x 4 x 5½ "	500
2½ x 4 x 5½ "	400
2½ x 5½ x 8 "	200
	Total, 3,500

These boxes accommodate a portion of the collection of bulky fungi, crustaceous lichens, fruits and seeds. The fungi and lichens are temporarily arranged in a store room near the main herbarium room, while the fruits and seeds are shelved at the southern end of the herbarium room. Both collections are accessible for comparison or study.

4. Arrangement of the Herbaria. The general plan of arrangement adopted last year has been essentially maintained. However a definite plan looking toward the best conservation and greatest usefulness of the specimens belonging to the Columbia University and Garden herbaria has been worked out and put into operation. The details of this plan are expressed in the following schedule:

MYXOMYCETES to be in boxes. Garden or Columbia University property to be indicated by stamp.

ALGAE. Garden and Columbia specimens both on 15½-inch paper but the property of each institution on separate sheets and stamped accordingly.

FUNGI. Garden and Columbia specimens both on 16½-inch paper but the property of each institution on separate sheets and stamped accordingly.

LICHENS. (Same arrangement as Fungi.)

BRYOPHYTES. (Same arrangement as Algae.)

PTERIDOPHYTES. Garden specimens on 16½-inch paper; Columbia on 15½-inch. The property of each institution in separate species-covers but in the same cases.

GYMNOSPERMS. (Same arrangement as Pteridophyta.)

ANGIOSPERMS. Garden specimens on 16½-inch paper; Columbia on 15½-inch. The property of each institution in separate cases.

(*a*) *Garden Herbarium.* The additions of herbarium specimens during the year amount to a total of fully 52,000. The Garden has been fortunate in being able to secure all of the desirable current distributions of herbarium specimens by purchase, gift or exchange. The herbarium has been especially enriched by the exploring trips already referred to and by the acquisition of the Mexican and European herbarium of Mr. A. Vigener, the algal herbarium of Dr. T. F. Allen, and the local herbarium of the Torrey Botanical Club.

About 45,000 sheets were mounted and incorporated into the Garden herbarium. This addition represents fully 49,625 specimens, for in the case of cryptogams, several specimens of the same species have often been mounted on one sheet.

The increasing need of a local herbarium representing the species growing naturally within a radius of one hundred miles from New York City and their distribution, was partly met in June when the Torrey Botanical Club presented its herbarium to the Garden. This herbarium consists of plants from within the area above mentioned and

hereafter most of the specimens from this area coming into the possession of the Garden will be incorporated into this collection, instead of into the general herbarium. This plan will make reference to the local plants easier and will reduce a certain amount of handling of the large collection which would otherwise be necessary.

(*b*) *Columbia University Herbarium.* About 8,057 specimens have come into the possession of Columbia University. Fully 10,747 sheets, representing about 11,022 specimens have been placed in its herbarium. The specimens on several thousand sheets of the moss collection that were temporarily mounted when that part of the herbarium was first brought into accessible condition, have been placed in uniform envelopes and remounted on new herbarinm sheets.

5. Uses of the Herbarium. The members of the Garden Staff have made constant use of these collections in matters relating to the development of the several departments, in the pedagogic work in connection with the various courses of instruction, for research work and special investigations. The members of the staff of the department of Botany of Columbia University have likewise made use of the herbarium. The registered students of both institutions have drawn on this source of information as their studies directed. Responsible persons not connected with either institution have used the collections for some definite purpose. Visiting officers and students of many colleges and universities have consulted such portions of the herbaria as their investigations required.

6. Plant Picture Collection. The first steps toward the bringing together of all the loose plates, photographs and drawings belonging to the institution were taken during the latter part of the year and considerable progress has been made in sorting pictures and making the collection accessible. The plan adopted is to arrange all the material in firm folders after the sequence of Engler and Prantl's "Die Naturlichen Pflanzenfamilien." The pictures will thus be readily accessible either for special pedagogic or herbarium work, or

may be withdrawn for incorporation into the museum, or for other purposes.

7. Extra Collections. Under the agreement with Columbia University, the herbaria designed for undergraduate teaching there and at Barnard College are being formed; a large portion of the Columbia material has been mounted and delivered to the head of the Department of Botany; a small portion of that intended for Barnard has been mounted and delivered, while a larger portion is in the process of being mounted.

8. Assistance. The large amount of detail work connected with the development of this department has been divided among the several members of the staff and volunteers. Dr. Rydberg has cared for most of the curatorial work in connection with flowering plants, Professor Underwood has cared for the ferns and fern-allies and Dr. Howe for the Hepatics and Algae. Mrs. Britton has done much to develop the collection of mosses and to get the specimens in accessible condition for study. Mr. Earle and Professor Underwood have taken special care of the collections of fungi and lichens and Dr. Hollick has had charge of the collection of fossil plants.

The museum aids, assigned to this department, have performed their duties with intelligence and ambition, and the coöperation of other members of the Garden staff has been all that could be desired.

Respectfully submitted,

J. K. Small,

Curator of the Museums and Herbarium.

December 31, 1901.

REPORT OF THE CURATOR OF THE ECONOMIC COLLECTIONS.

Dr. N. L. Britton, Director-in-Chief.

Sir: I have the honor to report continued progress in the accumulation and study of materials for the Economic Collections during the year 1901. The total number of specimens added is nearly 1,500. Besides a large number of scattering accessions, I would refer to the following specially important sets or collections:

A complete illustration of the manufacture of spool cotton thread, contributed by the Clark Thread Company, of Newark, N. J. This series includes raw material of different varieties, the material in each stage of manufacture and just as it comes from the machine, the forms of waste removed in the different operations, the effects of bleaching and of various dyes and a section of a spinning machine, of full size and workable. This exhibit is the more noteworthy because it embodies the idea of industrial exhibition treated in my previous annual reports. It is very unfortunate that we are obliged, for want of case-room, to postpone displaying this exhibit in an effective manner. More than half of it is still in the shipping cases, awaiting space for setting up.

The fine exhibit of hemp, and of hemp and other cordage and rope, referred to in my last report as promised by Messrs. Travers Bros., has been received, that firm having taken great trouble to make it complete and instructive. This set has been on exhibition since early in the year.

A considerable additional number of food products have been received from Messrs. F. H. Leggett & Company, and placed in the cases.

More than 500 specimens obtained by yourself, in Paris, have been added to the collection.

Small collections of economic material have been secured by yourself in St. Kitts, by Prof. L. M. Underwood in Porto Rico, by Mr. R. M. Harper in Georgia, and by my-

self at the Pan-American Exhibition. The large and important collection, including about 250 specimens, secured by Mr. Percy Wilson in the East Indies, deserves particular mention. Of these, again unfortunately, many cannot be exhibited at present, owing to the lack of cases.

A complete collection of North American woods, the samples small, but representing excellently their properties, has been donated by Mr. Morris K. Jesup and fills several cases in the eastern wing.

A set of gunpowder carbons and gunpowders has been contributed by the Hazard Powder Company.

A costly collection of vanilla beans has been donated by Messrs. Dodge & Olcott, of this city.

A large number of the specimens received from the Philadelphia Museum and the Field Columbian Museum, referred to in my last report, have been mounted in the cases and labelled; others are awaiting case room.

Owing to the exhaustion of our supply of museum jars, during the first half of the year, and also to the lack of case room, the work of securing exhibits was not active during the second six months, and attention was turned more especially to the study of material. A large number of species of South American plants were studied, and much careful work was done in studying important drugs. Three extensive papers dealing with the definitions and descriptions of drugs of the United States Pharmacopoeia, were published in the *Druggists Circular*, for September, October and November. A careful study was made of the Coca leaves of commerce, and a new species, *Erythroxylon Truxillense*, was described, the description drawn from living plants in our greenhouses. The nomenclature of a number of drugs long in dispute was critically studied, and a paper on the subject published in the *Druggists Circular* for December. Reference may be made to the fact that these reports, relating to drugs in their technical aspects, were deemed more appropriate for publication in a drug journal than in any of our own publications.

In the way of suggestions for the coming year, I would state that the studies above referred to have impressed me more than ever before, if this be possible, with the great value of botanically authenticated economic material. The lack of such authentication in the past has rendered much the larger part of the research work that has been done worse than worthless, since it has introduced discrepancies and contradictions which have tended to discredit the possibilities of science.

As the Garden develops, an increasing amount of this research work is likely to be performed here, and we should endeavor from the beginning to eliminate errors due to this cause from our results. Our Board of Scientific Directors can hardly overestimate the importance of utilizing every opportunity for obtaining economic material by the hands of trained collectors, who shall not only satisfy themselves of its identity, but preserve collection-records which shall place such identity beyond the reach of future question. One such opportunity has been embraced during the past year, by engaging Mr. Eugene Ackermann to collect certain articles for us in the Amazon valley. Several of these will probably enable us to determine in future some important commercial questions which have frequently been unanswerable in this city in the past.

Finally, I would recommend that a provision for new cases be made as soon as the funds will warrant, and I would further advise that when this addition is made, an attempt should be made to change the character of the present cases, so as to eliminate some existing difficulties.

Respectfully submitted,

H. H. RUSBY,

Curator of the Economic Collections.

REPORT OF THE DIRECTOR OF THE LABORATORIES.

DR. N. L. BRITTON, DIRECTOR-IN-CHIEF.

Dear Sir: I have the honor to submit the following report for the year ending January 1, 1902.

The equipment of the laboratories has been increased to meet the constantly widening scope of investigations taken up. Various apparatus and instruments of precision have been secured, and also much valuable material which may not appear on an invoice of permanent equipment. A dozen desks after plans approved by the director, suitable for research work, have been secured. Every available table is now occupied. The most pressing need of the laboratories, however, is that of cases suitable for the reception and proper protection of the more delicate apparatus.

The investigation of certain economic problems in vegetable dyes, and in pathology has made necessary the arrangement of the chemical laboratories for practical work, and it will be necessary to develop the equipment in this branch at the earliest possible moment. Additional apparatus for sectioning and preparation of paleobotanical specimens are also needed.

The collection of old microscopes presented by Mr. C. F. Cox, has been suitably placed in a case in a corridor in the laboratories and forms an exhibit very attractive to visitors.

The study of the meteorological conditions in the Garden has been continued, and a method devised for the estimation of the thermal values of climates. This plan has met the approval of the "Committee on Relation of Climate to Vegetation," of the American Association for Advancement of Science, of which I have the honor to be a member. A form of thermograph suitable for the continuous registration of temperatures of the soil has been constructed after plans by Dr. Wm. Halleck, of the Department of Physics of Columbia University. Temperature and humidity tests made in the

conservatories have been of service to the gardening department in bringing the ranges under control.

The JOURNAL has been published monthly during the year, the completed volume making 212 pages, including 5 plates and 10 figures. A Practical Text Book of Plant Physiology, a volume of 352 pages and 159 figures, has been published by Longmans, Green & Co., who also have in press a new manual of "Elementary Plant Physiology" by myself.

Investigations on the relation of light to the development and growth of plants begun in 1896, are now being completed and the manuscript of the essay on the subject will be offered for publication in the Memoirs at an early date. In addition to my own work, the usual guidance and assistance has been rendered to students in the laboratories.

Lectures and addresses have been given to various horticultural and botanical societies, and also at several colleges.

The results of special studies of members of the staff and students have appeared in the publications of the Garden, and in other periodicals, and some are still in press.

In accordance with an arrangement between the Garden and the University of Montana, I visited that institution in June, and arranged for the shipment of its collection of herbarium specimens to the Garden for determination. I also formed a member of the biological expedition which made explorations in the Mission and Kootenai mountains, and around Flathead Lake, maintaining a summer laboratory at Big Fork, at the northern end of the lake, during July and August.

I attended the meeting of the American Association for Advancement of Science, at Denver, in August, filling the position of Secretary of the Council, and had the honor to be elected General Secretary for the ensuing year.

During the absence of the Director-in-Chief in St. Kitts in September and October, the duties of that office were discharged by me from September 1st to October 10th.

The weekly conventions of the working botanists of New York at the museum have been continued, and the subjects

brought under discussion have been duly noted in the JOURNAL from time to time.

The following persons have had the privilege of students during the year:

Alice Irene Barrett.

Frederick H. Blodgett, B.S., Rutger's College, 1897; M.S., 1899.

Jean Broadhurst.

Louise Bruchmann, Normal College.

William Austin Cannon, A.B., Stanford University, 1900.

Bertha McLane Dow.

Alice Dufour, Ph.D., Defiance College, 1899.

Julia Titus Emerson.

Charles Winthrop Gilman.

John R. Gardner, B.S., Fayette College, 1891; C.E., Iowa State College, 1894.

Sarah H. Harlow, A.B., Wellesley College, 1891.

Roland McMillan Harper, B.E., University of Georgia, 1897.

Lenda Tracy Hanks, A.B., Columbia University, 1901.

Caroline Coventry Haynes.

Joseph Edward Kirkwood, A.B., Pacific University, 1898; A.M., graduate student Princeton University, 1898–1899.

Elsie W. Kornmann, Normal College.

Elsie Kupfer, A.B., Columbia University, 1899; A.M., 1901.

Emily Pauline Locke, B.L., Smith College, 1900.

Delia West Marble.

Ernestine Molwitz.

Ida Helen Ogilvie, A.B., Bryn Mawr, 1900.

Edith Edwina Rand, A.B., Smith College, 1899.

Rosina Julia Rennert, A.B., Normal College, 1897.

Cornelia Janney Shoemaker, A.B., Swarthmore, 1894.

Florence W. Slater, B.S., Cornell University, 1900.

Violette S. White.

Charles Zeleny, B.S., University of Minnesota, 1898; M.S., 1901.

Respectfully submitted,

D. T. MACDOUGAL,

Director of the Laboratories.

REPORT OF THE LIBRARIAN.

To the Director-in-Chief:

Dear Sir: I beg to submit the following report on the Library, covering the period from January 1, 1901, to January 1, 1902:

The last census of the Library was taken on December 28th, and the number of bound volumes was then shown to be 11,314, showing an increase for the year of 2,482 volumes. Of these, 569 volumes were presented to the Garden, 825 volumes were purchased by the Special Book Fund and 256 volumes were deposited at the Garden by Columbia University, the remainder being acquired through subscription or by exchange.

The card catalogue of the books deposited at the Garden by Columbia University in December, 1899, has been completed, and the entire collection of the books belonging to the Garden has also been catalogued.

The binding of the books and pamphlets belonging to both institutions has progressed satisfactorily, and 973 volumes have been bound during the year, of which 273 were serials and pamphlets belonging to Columbia University.

A most important addition to the Library is the collection of books on paleobotany belonging to Columbia University, which, according to an agreement, dated May 3, 1901, between the two institutions, was transferred to the Garden during the month of November. It is temporarily installed in the rotunda of the Library until suitable shelves can be built for it, and consists of 200 volumes and some 300 unbound pamphlets.

Other valuable additions are a collection of books on the Characeae, the gift of Dr. Timothy F. Allen, and of several sets of serials, mainly on microscopy, the gift of the Rev. Dr. Haslett McKim.

Several important horticultural serials have been procured, thus adding materially to the effectiveness of that depart-

ment. The series of books on the orchid family has been increased by the purchase of some valuable and costly illustrated volumes and quite a number of fine old books on landscape gardening have been added to the collection.

At a meeting of the Torrey Botanical Club on February 12, 1901, the club adopted the following resolution in regard to the disposition of their numerous exchanges: "That the future exchanges of the Torrey Club become the property of the New York Botanical Garden (except in the case of sets which are already in part the property of Columbia University) with the proviso that the Garden reciprocate by allowing the members full and free access to the Garden Library." A list of these exchanges is appended to this report.

The duplicate working collections of books in the laboratory and in the herbarium have been considerably enlarged during the year.

Accessions to the Library, other than the serials and regular exchanges, have been published monthly in the Journal.

List of Exchanges.

Institutions.

Agricultural Experiment Station, Auburn, Ala.
" " " Uniontown, Ala.
" " " Tucson, Arizona.
" " " Fayetteville, Ark.
" " " Berkeley, Calif.
" " " Fort Collins, Colo.
" " " New Haven, Conn.
" " " Storrs School, Conn.
" " " Newark, Del.
" " " Lake City, Fla.
" " " Experiment, Ga.
" " " Moscow, Idaho.
" " " Urbana, Ill.
" " " Lafayette, Ind.
" " " Ames, Iowa.
" " " Manhattan, Kans.
" " " Lexington, Ky.

Agricultural Experiment Station, Baton Rouge, La.
" " " Orono, Me.
" " " College Park, Md.
" " " Amherst, Mass.
" " " Agricultural College, Mich.
" " " St. Anthony Park, St. Paul, Minn.
" " " Agricultural College, Miss.
" " " Columbia, Mo.
" " " Bozeman, Montana.
" " " Lincoln, Nebr.
" " " Reno, Nev.
" " " Fargo, N. Dak.
" " " Durham, N. H.
" " " New Brunswick, N. J.
" " " Mesilla Park, N. Mex.
" " " Geneva, N. Y.
" " " Ithaca, N. Y.
" " " Raleigh, N. C.
" " " Wooster, Ohio.
" " " Stillwater, Oklahama.
" " " Corvallis, Oregon.
" " " State College, Pa.
" " " Kingston, R. I.
" " " Clemson College, S. C.
" " " Brookings, S. Dak.
" " " Knoxville, Tenn.
" " " College Station, Texas.
" " " Logan, Utah.
" " " Burlington, Vt.
" " " Blacksburg, Va.
" " " Morgantown, W. Va.
" " " Pullman, Washington.
" " " Madison, Wis.
" " " Laramie, Wyo.

Bulletins and *Reports*.

Agricultural Bulletin of the Malay Peninsula, Singapore, Straits Settlement.

Agricultural Department of the West Indies, Barbadoes, W. I. *Bulletin.*

American Museum of Natural History, New York City, N. Y. *Journal.*

Biltmore Herbarium, Biltmore, N. C. *Botanical Studies.*

Bishop Museum, Honolulu, Hawaiian Islands.

Botanic Gardens, Singapore, Straits Settlement. *Annual Report.*

Botanic Gardens, Sydney, New South Wales. *Report.*

Botanic Institute of the University of Stockholm, Stockholm, Sweden. *Meddelanden.*

Botanical Department, Jamaica, West Indies. *Bulletin.*

Botanical Gardens, Cincinnati, Ohio.

Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y.

California State Board of Horticulture, Sacramento, California, *Report.*

Central Experiment Farm, Ottawa, Canada. *Bulletin, Report.*

College of Pharmacy, New York City, N. Y. *Journal of Pharmacology.*

Columbia University, New York City, N. Y. *Memoirs* and *Contributions from the Department of Botany.*

Denison University, Granville, Ohio. *Bulletin of the Scientific Laboratories.*

Eli Lilly and Company, Indianapolis, Ind.

Field Columbian Museum, Jackson Park, Chicago, Ill. *Publications; Report Series* and *Botanical Series.*

Geological and Natural History Survey of Minnesota, Minneapolis, Minn. *Report and Bulletin.*

Geological and Natural History Survey of Canada, Ottawa, Canada. *Contributions from the Herbarium.*

Geological and Natural History Survey of Maryland, Baltimore, Md.

Herbarium of Harvard University, Cambridge, Mass. *Contributions from the Gray Herbarium.*

Herbier Boissier, Geneva, Switzerland. *Bulletin.*

Illinois State Laboratory of Natural History, Springfield, Ill. *Bulletin.*

Instituto Fisico-Geografico de Costa-Rica, San José de Costa-Rica, C. A. *Boletin.*

Instituto Medico National, Mexico, Mexico. *Anales.*

Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa. *Contributions from the Botanical Laboratory.*

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- Division of Forestry. All publications.
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Respectfully submitted,

Anna Murray Vail,

Librarian.

REPORT OF THE HEAD GARDENER.

To the Director-in-Chief.

Sir: I have the honor to submit herewith my report as Head Gardener for the year 1901 :

The past year has been a most active one in the department under my control. In addition to the work of caring for the constantly increasing collections of living plants, I assumed also, upon my appointment last January as head gardener, the direction of all gardening operations. I have been ably seconded in carrying out the details of this horticultural work by Mr. Geo. A. Skene, second gardener. He has had to assist him in this work two foreman-gardeners, ten or eleven gardeners and apprentices, and a number of laborers, varying from three to five. Of this force, one foreman-gardener and six or seven gardeners and apprentices have been detailed to the public conservatories; during wet or severely cold weather the men detailed for outside work have also assisted here.

The propagating houses and nurseries have required the services of one foreman-gardener, one apprentice and one laborer, the latter being dispensed with on the arrival of freezing weather, when work in the nurseries necessarily ceases.

The herbaceous grounds were cared for during the spring by two men, but the added area taken under cultivation during the fall of the previous year soon made apparent the necessity for a third man, which need was supplied for the balance of the growing season by the detail of an additional laborer, making a force of one gardener and two laborers. It required the entire time of these three to keep the large number of beds in this plantation properly weeded and cultivated and the grass edges trimmed, the brook and pools cleaned of the constantly accumulating scum and weeds, and to do the necessary hand-mowing, bed-digging, planting and trans-planting.

The remainder of the force, one gardener and two laborers, has devoted its time to cultural work of a miscellaneous

character, viz: the weeding and necessary cultivation of the beds in the fruticetum and borders and of the large rose bed, and of the circles around the trees in the arboretum and pinetum; the weekly mowing of grass around the conservatories, on the triangle, and on the areas in the vicinity of the station and of the museum, such portions as could not be advantageously cut with the horse-mower; the pruning of shrubs and trees; and the trimming of paths and roads. The larger part of the mowing was accomplished with the horse-mower by one of the drivers detailed for the purpose.

Upon the cessation of outdoor gardening operations, the laborers detailed for this purpose were transferred, two of them being placed with a gardener who is in charge at present of tree-felling, the remainder again reporting to the superintendent. A number of trees in the vicinity of the lakes and the nurseries and in the wooded areas have died from one cause or another, or have been blown down, and their removal is necessary. Two dead trees along the lower lake, four in the hemlock forest, blown over during a heavy rainstorm, and several in other parts of the grounds, have already been removed, and the wood secured has been stored in the vicinity of the propagating houses for fuel.

The gardener in charge of the herbaceous grounds, with the assistance of a wagon and driver, has been kept busy for several weeks mulching with manure the beds in the herbaceous grounds and fruticetum, the west border and adjacent rose bed, and the shrub beds in the vicinity of the museum and station. The remaining outside gardener, unless otherwise employed, is detailed for work in the conservatories.

Another important work being prosecuted is the forming of leaf-mold piles. The same force employed in mulching the beds, with the addition of an extra gardener, are engaged part of the time in this necessary matter. Two of these piles were made the early part of the year, resulting by fall in a fine quality of leaf-mold. Too much of this material cannot be secured, as it is extensively used both at the propagating houses and in the conservatories.

Decorative Plantations.

In the decorative plantations some planting has been done the past fall, although the greater part of this work must await the completion of the paths and roads in the vicinity of the large buildings. Owing to a change in grade in the vicinity of the road fountain in front of the museum, it has been necessary to temporarily dispense with the bed which was devoted to the honeysuckle family. The shrubs contained in this bed were transferred to two others, the larger portion going to the new bed opposite that containing the spiraeas, the remaining viburnums serving to partially fill the beds in the triangle.

Along the west border considerable planting of herbaceous perennials was effected in the spring, many of the gaps of the preceding year being acceptably filled with desirable material from the west nursery.

Systematic Plantations.

Herbaceous Grounds. The greatest increase in species has been in this plantation, where there have been grown during the past year 3,012 species. This is an increase of more than 500 species over the number of the previous year. Many other species are being tested in the trial grounds at the nursery, and such as prove themselves adapted to our climate will be transplanted in the spring, greatly augmenting the representation in this collection.

A part of the re-arrangement of the beds here, necessitated by this large accession of new species, was completed during the fall. Beds of the Knotweed Family were enlarged, as were those of the Pink, Crowfoot, Barberry, Orpine, Rose, Geranium, Phlox, Mint, Bell-flower, Thistle, Fern, Lily and Iris families. New beds were added to the Saxifrage, Milkweed, Mint and Lily families. The bed formerly devoted to the Vervain family was transferred to the Mint family and the former moved to a smaller bed to the north. The bed previously containing the Potato family was also absorbed by the rapidly increasing collection of the Mint family and

the former transferred to a newly prepared bed but a short distance north. Owing to peculiar conditions found necessary for the proper cultivation of certain plants, it has proved advisable to change the positions of the beds devoted to the Poppy, Fumitory, Mignonette, Milkwort and Gentian families, their relative positions in the sequence, however, being preserved. Rockeries have been provided for the rock-loving crucifers and saxifrages. The construction of the path along the westerly ridge made necessary the transferral of the bed given up to the Cactus family to a position opposite its former one, thus furnishing better conditions for the growth of these plants and ample opportunity for expansion as the collection grows. One new bed was also prepared for the Mimosa family, not hitherto represented here.

For some time large masses of rock in some of the plots have interfered considerably with the proper cultivation of the plants in them. This rock was especially troublesome in one of the large beds of the Thistle family, where an enormous boulder obstructed one end. This was blasted and the shattered rock removed to a depth of about two feet, being replaced with top soil. The same treatment was applied to one of the beds of the Mint family, to one of those of the Foxglove family, and to that of the Potato family.

Fruticetum. The number of species here has been considerably increased, the collection now embracing 512 species, represented by 1,037 shrubs.

Salicetum. This group has been increased by the addition of a number of species of willows and poplars obtained from the west nursery, where they have been accumulating for several years. There are now under cultivation here 43 species, represented by about 125 plants.

Arboretum. Few direct additions have been made to this plantation. The collection now contains, including those still in the nurseries and those native to the tract or previously introduced, 217 species.

Pinetum. The conifers in place are represented by 49 plants, comprising 16 species; 65 additional species are in the nurseries.

Viticetum. Many of the vines are making a good growth which has necessitated considerable tying up and training. The collection remains essentially as previously reported.

Nurseries and Propagating Houses.

A large amount of work, both of a cultural and experimental nature, has been conducted here, and the range, one house of which still awaits construction, has been taxed to its utmost to accommodate the demands made upon it.

Over 6,000 packets of seed have been sown, and from this source have already been obtained and accessioned over 8,500 plants. Of these seeds a large number were of trees and shrubs, many of which will require a year or two in which to germinate, so that many more plants will be ultimately obtained.

The conservatory collection has been especially augmented from this source, many interesting and showy species being among the number. Many of the plants are rapidly approaching a size which will permit of their removal to the conservatories. There are about 1,000 species here not represented at present in the conservatories. In addition to the enrichment of the collection, a large amount of duplicate material has also been thus secured which can be most advantageously used in exchanges with other institutions.

The herbaceous grounds have also been much enriched from the same source, several hundred species having already been removed thence, and many more will undoubtedly follow in the spring from the trial grounds.

Of the five compartments which at present compose this range, four are devoted to horticultural purposes; the fifth is intended for experimental work and is run in connection with the laboratories. Owing to the demands of the purely horticultural work, it has been necessary to trespass somewhat upon this room, but this has been done only when absolutely unavoidable. The importance of this experimental work has been fully realized, and every facility in the way of plants or assistance has been placed at the disposal of investigators and students.

What has previously been called the west nursery was partly cleared of plants during the spring, the soggy condition of the soil in the lower end at that time preventing the removal of the willows and poplars there located. These were removed during the fall, the fruticetum and salicetum receiving such as were needed in their respective collections. A few specimens of each species were transferred to the north border, the remainder being destroyed. The whole area was then cleared of all weeds and rubbish, and now awaits plowing and harrowing, preparatory to seeding down with grass.

Public Conservatories.

It is here that the progress of the past year has been most marked; the collections have been greatly improved, both in general appearance and in fuller representation of species. Owing to the continued kindness and generosity of the friends of the Garden, many valuable accessions have been made which were duly recorded in the JOURNAL from time to time. A provisional arrangement of the families was made early in the year, and with comparatively few changes this still obtains.

Much time and attention have been devoted to labelling and classifying the large collections. Show labels to the number of 1,383 have been put in position, many herbarium specimens collected and in great part named, and the determination of many other plant names effected.

The collection here now comprises a total of 3,344 species, represented by 7,974 specimens, disposed as follows:

House no.	1	128
" "	2	304
" "	3	268
" "	4	364
" "	5	1,018
" "	11	503
" "	12	463
" "	13	296
		3,344

Labelling, Accessioning and Herbarium.

Two apprentices have been kept constantly busy in this department. One has had in charge the manufacture and lettering of exhibition labels for the various plantations and the conservatories, and in addition has practically done all the sign work, other than that performed by the printer, which has been required in various parts of the buildings. For the conservatories 1,383 zinc labels and for the trees 306 have been manufactured, painted and lettered. In addition to these, 221 wooden labels for the fruticetum and 524 for the herbaceous grounds have been painted and lettered. This makes a total of 2,434 show labels for exhibition purposes. About 75 of the family signs in the herbaceous grounds were also repainted and lettered.

The other assistant has attended to the accessioning of all plants and seedlings, the writing of data labels, the collecting of herbarium specimens, and the posting of the card catalogue from the accession books. During the past year accession numbers 4,890–10,650 have been registered, showing a total of 5,761 accessions. To the herbarium of cultivated plants 1,291 sheets have been added.

During the year there have been accessioned 15,736 plants; of these 8,561 were derived from seed sown during the spring. There are many other small seedlings, not yet large enough for potting.

During the fall the data labels on all plants in the arboretum, pinetum, salicetum and fruticetum were inspected, and where necessary removed to smaller branches to prevent the attaching wire cutting into the bark; where labels were missing new ones were supplied. The plants requiring them in the herbaceous grounds and the herbaceous plants in the nurseries were all supplied with the usual zinc data label. The wooden labels for the seeds of shrubs and trees sown in the cold frames, and for seedlings there too small to be transplanted, were replaced with new ones plainly written, so that all data may be preserved.

The following table shows the approximate number of species in each plantation and in the conservatories and the number of species native to the Garden, together with the total number, both wild and cultivated.

Public Conservatories	3,344
Herbaceous Grounds	3,012
Fruticetum	512
Arboretum	169
Pinetum	16
Salicetum	43
Viticetum	65
Propagating Houses, species other than those already in the conservatories	1,000
Nurseries, species other than those already in the plantations given below:	
Herbaceous Grounds	331
Fruticetum	11
Arboretum	48
Pinetum	65
Wild Flora	657
	9,273

Respectfully submitted,

George V. Nash,
Head Gardener.

REPORT OF THE SUPERINTENDENT OF BUILDINGS AND GROUNDS.

To the Director-in-Chief.

Sir: I have the honor to submit herewith the report of this department, for the year ending December 31, 1901:

Buildings.

1. *Museum.* This as a new structure is in fair condition. There is very little settlement of walls or partitions noticeable but an overhauling in the early part of the season, such as patching up plaster work and repairing of window frames in the interior, and the painting of some of the terra cotta and brick work on the exterior, will be advisable for their proper preservation. The sub-cellar under the lecture hall was flooded during a heavy rainstorm in spring; the insertion of screw-tubes has considerably improved the drainage.

The construction of water faucets and sinks for waste water, one on each of the two public exhibition floors, is a needed improvement, which would greatly facilitate the proper cleansing of the floors.

2. *Barn.* An additional hay barrack with a storage capacity of thirty tons, has been erected. The stables are in good sanitary condition. We had no serious sickness of horses, nor the need of veterinary services during the year. The hay crop of the season amounted to about twenty-four tons of good quality. The cost of oats, bran and salt used, amounted to $471.71. With the exception of one cart, all the wagons, carts, harness and other stable equipments are in good condition.

The agricultural machinery we have consists of: 2 mowing machines, 2 lawn mowers, 1 horse rake, 1 plow, 1 harrow, 1 new 500-pound garden roller, 1 hay shocker, and 4 grass cutters. Few small repairs and painting will put them all in the best condition.

Construction of Roads and Paths.

We have graded and paved 786 feet of road, 25 feet in width, prepared to be covered with trap rock and screenings; also paths 10 and 11 feet in width, as follows: 680 feet from drinking fountain to the herbaceous grounds; 2,240 feet on the herbaceous grounds; 656 feet from the museum to the West Lake; 180 feet between the East Lake and the Bronx River; 680 feet in addition to paths constructed in 1900, north of southern boulevard; total, 4,436 feet now completed for screening cover.

A road 350 feet in length and 15 feet in width has also been built in the rear of the museum, leading to the delivery door.

An excavation of about nine thousand cubic feet was made east of the museum building, and filled with top soil.

Water Pipes.

During the year we have laid and made connections for water pipes as follows: 896 feet of six-inch black pipe from a spur about 100 feet south of the museum to the lakes; 2,875 feet of two-inch galvanized iron pipe, connected with the six-inch black pipes at the west lake and leading to the propagating houses; 486 feet of two-inch galvanized pipe, leading from the six-inch pipe and connecting with the public comfort station; 180 feet of one-inch to the stables; 140 feet of one-inch (temporary) to the nurseries; 54 feet of two-inch along the walls of the railroad station; 4,631 feet, total.

There were also completed, one six-inch and three two-inch water-gates, with man-holes.

There have been hung and laid 4,210 feet of electric telephone wire, connecting museum, barn and propagating houses.

Drainage.

Nine catch basins were constructed and connected with the main drains; seven of them were built of hard brick and portland cement, and two of twenty-four-inch double-strength sewer pipe; all six feet in depth with cast-iron covers.

About 430 feet of six-inch sewer-pipe were laid from the stables to a point north of the road; also a sewer from the public comfort station 234 feet long, to the main sewer. The work on the twenty-four-inch sewer on the southern boulevard is progressing and, if the weather permits, will be completed early in the spring.

We have regulated, graded and sodded 37,560 square feet of slopes and gutters.

Respectfully submitted,

F. A. SCHILLING,

Superintendent of Buildings and Grounds.

SCHEDULE OF EXPENDITURES DURING 1901, UNDER APPROPRIATIONS MADE BY THE BOARD OF MANAGERS.

1. City Maintenance Account		$55,000.00
Salaries and Labor.		
Appropriated	43,046.75	
Expended	43,046.75	
Supplies and Repairs.		
Appropriated	11,953.25	
Expended	11,953.25	
Total Expended		55,000.00
Construction and Improving the Grounds		9,999.87
Total Expended		9,999.87

2. Garden Accounts.

Museums and Herbarium.

Appropriated		2,500.00
Expended	2,489.91	
Transferred to Special Assistance	10.00	2,499.91
Balance		.09

Library.

Appropriated	1,325.00	
Transferred from Circulars for Membership	99.40	1,424.40
Expended		1,423.98
Balance		.42

Laboratories.

Appropriated		1,000.00
Expended		999.80
Balance		.20

Publications.

Appropriated..........	1,300.00	
Transferred from Horticultural Prizes........	195.35	
Transferred from Lectures......................	146.40	
Transferred from Purchase of Plants.........	21.80	1,663.55
Expended...		1,660.05
Balance		3.50

Exploration and Collecting.

Appropriated..		1,750.00
Expended...		1,749.18
Balance..............................		.82

Lectures.

Appropriated..		500.00
Expended...	353.60	
Transferred to Publications.................	146.40	500.00

Horticultural Prizes.

Appropriated..		1,000.00
Expended...........................	804.65	
Transferred to publications.....................	195.35	1,000.00

Contingent Fund.

Appropriated	1,400.00	
Transferred from Grading, Drainage and Water Supply	600.00	2,000.00
Expended		1,999.70
Balance		.30

Stable Equipment.

Appropriated..		200.00
Expended		195.44
Balance..............................		4.56

Purchase of Plants.

Appropriated		550.00
Expended...	527.35	
Transferred to Publications....................	21.80	549.15
Balance..............................		.85

Circulars for Membership.

Appropriated		475.00
Expended	372.00	
Transferred to Library	99.40	471.40
Balance		3.60

Special Assistance.

Appropriated	475.00	
Transferred from Museums and Herbarium	10.00	485.00
Expended		485.00

Landscape Engineering.

Appropriated		720.00
Expended		720.00

Insurance on Collections.

Appropriated		600.00
Expended		576.00
Balance		24.00

Grading, Drainage and Water Supply.

Appropriated	4,000.00	
Refund on Voucher Paid (N. Y. C. & H. R. R. R. Co.)	102.50	4,102.50
Expended	3,494.83	
Transferred to Contingent Fund	600.00	4,094.83
Balance		7.67

Special Appropriation by Executive Committee, May 23, 1901.

Appropriated		167.00
Expended		167.00

Plans and Specifications.

Appropriated		120.00
Expended		120.00
Total Appropriated for Garden Accounts	18,082.00	
Refund	102.50	18,184.50
Total Expended for Garden Accounts		18,138.49
Balance		46.01

3. Special Garden Accounts.

Conservatory Fund.

Subscribed 1900	2,110.00	
Subscribed 1901	25.00	
Refund—Balance on Draft	15.27	2,150.27
Expended 1900	710.44	
Expended 1901	1,437.42	2,147.86
Balance		2.41

Special Book Fund.

Subscribed 1899	4,950.00	
Subscribed 1901	1,825.00	6,775.00
Expended 1899	1,916.65	
Expended 1900	2,395.28	
Expended 1901	2,449.03	6,760.96
Balance		14.04

Exploration Fund.

Subscribed	2,050.00	
Refunds—Balance on Drafts	87.59	2,137.59
Expended		2,130.95
Balance		6.64

Museum and Herbarium Fund.

Subscribed	1,800.00
Expended	1,546.19
Balance	253.81
Total Expenditures from Funds of the Garden	25,702.08

Walter S. Groesbeck,
Accountant.

New York, January 13, 1902.

REPORT OF THE SCIENTIFIC DIRECTORS.

To the Board of Managers,
New York Botanical Garden.

Gentlemen: I have the honor to submit herewith the report of the Board of Scientific Directors for the year now closing.

The Scientific Directors have held three meetings during the year, on April 12th, October 22d, and December 6th respectively.

At the first meeting a report was received of the very extensive additions to the collection of living plants made at the Royal Botanical Gardens, Kew, by Mr. Nash. This was made possible by the liberality of Sir William Thiselton-Dyer, the director at Kew, and due acknowledgment was made for this extensive favor which has already resulted in the accession of fifteen hundred living plants, and the promise of as many more.

Leave of absence to various members of the staff was approved in order for them to engage in botanical exploration during the summer.

Your honorable body was also asked to set aside a portion of the income from the bequest of the late Judge Daly to facilitate the preparation of a systematic botany of North America. At the second meeting, various details of this work were determined, such as the amount per printed page to be paid to contributors and the approval of certain American botanists as an advisory committee to the editors. Further details relating to preparation and publication were left to Dr. N. L. Britton and Professor Underwood with power.

The definite provision for the publication of this work represents the consummation of plans that took their origin several years ago and have since been slowly maturing. The work is on a scale far more extensive than any that has yet been proposed, and contemplates a systematic flora of the entire continent of North America together with that of

the West India islands describing all the plants from the lowest to the highest in something over thirty octavo volumes. This, therefore, represents one of the most important steps yet taken by the board.

At this meeting also your honorable body was asked to set aside one thousand dollars each year as an aid to making comparisons of our flora with authentic material in American or European herbaria. Increases of appropriation for the current year were made to the library fund, the publication fund, the contingent fund, the museum and herbarium fund, and for the purchase of living plants. Following the appointment of two additional members to the staff, four additional courses of study were approved: one in plant pathology by Mr. Earle and one in paleobotany by Dr. Hollick.

At the December meeting, a vacancy having occurred in the board by the resignation of Hon. Seth Low from the presidency of Columbia University, the undersigned was elected chairman of the Board of Scientific Directors. A plan was adapted for the utilization of the Stokes fund for the preservation of our native plants from wanton destruction, by which a series of prizes were offered for essays on the subject. These essays are to be published in the JOURNAL of the Garden and otherwise distributed. Authorization was granted the Director to appeal for a fund not to exceed five thousands dollars for stocking the recently completed portions of the conservatory. The budget for 1902 so far as it related to salaries of scientific aids and the development of the scientific work of the Garden was approved, and the request was made of your honorable body to consider plans for increasing the present endowment of the Garden to the sum of five hundred thousand dollars. Reports were also received of exploration in the West Indies by the Director and by Professor L. M. Underwood and ordered printed in the JOURNAL.

From these general statements it will be seen that the scientific development of the Garden is rapidly widening in the direction of furnishing additional facilities for research, in the

exploration of portions of America little known botanically, and in the publication of results of scientific investigation for the better diffusion of knowledge and the instruction of the public. It is in these ways that the highest function of a scientific institution can be fostered and extended.

Very respectfully yours,

LUCIEN M. UNDERWOOD,

Chairman.

JANUARY 13, 1902.

REPORT OF THE COMMITTEE ON PATRONS, FELLOWS AND MEMBERS.

To the Board of Managers of the New York Botanical Garden.

Gentlemen: The number of new members who have qualified during the past year is 92. The total number of annual members is now 860.

Of these 27 are in arrears for dues for 1901 and four are in arrears for dues for 1900 and 1901.

Annual dues have been collected to the amount of $8,550.00, which has been transmitted to the Treasurer as received.

Fifteen persons have qualified as life members by the payment of $100 each. Two persons have qualified as Fellows for Life by the payment of $1,500 each. These sums have been transmitted to the Treasurer for credit to the Endowment Fund.

A complete list of Patrons, Fellows for Life, Life Members and Annual Members to date is herewith submitted.

New York, January 13, 1902.

Patrons.

Hon. Addison Brown,
Andrew Carnegie,
Columbia College,
*James M. Constable,
*Hon. Chas. P. Daly,
Wm. E. Dodge,
Geo. J. Gould,
Helen M. Gould,
Mrs. Esther Herrman,
John S. Kennedy,
D. O. Mills,
J. Pierpont Morgan,
*Oswald Ottendorfer,
John D. Rockefeller,
William Rockefeller,
Wm. C. Schermerhorn,
Jas. A. Scrymser,
Samuel Sloan,
*Cornelius Vanderbilt,
Mrs. Antoinette Eno Wood.

*Deceased.

Fellows for Life.

Mrs. Melissa P. Dodge,
David B. Ivison,
Morris K. Jesup,
John Innes Kane,
Hon. Seth Low,
Miss Caroline Phelps Stokes,
Miss Olivia E. Phelps Stokes,
Samuel Thorne,
Tiffany & Co.,
H. C. von Post.

Life Members.

Edward D. Adams,
A. G. Agnew,
Mrs. James H. Aldrich,
Richard H. Allen,
Constant A. Andrews,
Samuel P. Avery,
Samuel D. Babcock,
Geo. V. N. Baldwin,
Dr. John H. Barnhart,
Gustav Baumann,
Samuel R. Betts,
J. O. Bloss,
George Blumenthal,
George C. Boldt,
Geo. S. Bowdoin,
Hugh J. Chisolm,
E. Dwight Church,
Mrs. Alfred C. Clark,
Geo. C. Clark,
Banyer Clarkson,
Wm. F. Cochran,
William Colgate,
Miss Georgette T. A. Collier,
Mrs. William Combe,
W. E. Connor,
Theodore Cooper,
Melville E. Day,
Miss Julia L. Delafield,
Maturin L. Delafield, Jr.,
Miss Ethel DuBois,
Miss Katharine DuBois,
Wm. A. DuBois,
Mrs. John Dwight,
Newbold Edgar,
George Ehret,
David L. Einstein,
Ambrose K. Ely,
Amos F. Eno,
Edward J. Farrell,
Andrew Fletcher,
Chas. R. Flint,
Col. De Lancey Floyd-Jones,
James B. Ford,
Mrs. Theodore Kane Gibbs,
James J. Goodwin,
J. B. M. Grosvenor,
Bernard G. Gunther,
Franklin L. Gunther,
Frederic R. Halsey,
H. O. Havemeyer,
Very Rev. E. A. Hoffman,
George B. Hopkins,
Archer M. Huntington,
Frank D. Hurtt,
Adrian Iselin,
Theo. F. Jackson,
Dr. E. G. Janeway,
Miss Annie B. Jennings,
Walter R. T. Jones,
Eugene Kelly, Jr.,
Nathaniel F. Kidder,
W. B. Kunhardt,

Mrs. George Lewis,
W. H. Louis, Jr.,
Joseph Loth,
David Lydig,
Wm. H. Macy, Jr.,
Edgar L. Marston,
A. G. Mills,
Roland G. Mitchell,
John G. Moore,
A. Lanfear Norrie,
Gordon Norrie,
Geo. M. Olcott,
Mrs. Chas. Tyler Olmsted,
Geo. Foster Peabody,
James Tolman Pyle,
M. Taylor Pyne,
Geo. W. Quintard,
Jacob M. Rich,
H. H. Rogers,
Reginald H. Sayre,
Edward C. Schaefer,
Mrs. I. Blair Scribner,
Isaac N. Seligman,
Francis L. Stetson,
Anson Phelps Stokes,
Charles G. Thompson,
Robert M. Thompson,
Wm. Stewart Tod,
Spencer Trask,
Miss Susan Travers,
F. T. Van Bensen,
Dr. Henry F. Walker,
F. N. Warburg,
John I. Waterbury,
S. D. Webb,
John D. Wing.

Annual Members.

Dr. Robert Abbe,
Ernest K. Adams,
Samuel Adams,
Mrs. Cornelius R. Agnew,
Miss Elizabeth Agnew,
R. Percy Alden,
Jas. A. Alexander,
J. H. Alexander,
John E. Alexandre,
C. L. Allen,
Dr. Timothy F. Allen,
Wm. C. Alpers,
Bernard G. Amend,
James L. Amerman,
John A. Amundson,
Arthur A. Anderson,
J. M. Andreini,
J. Sherlock Andrews,
A. B. Ansbacher,
Wm. A. Anthony,
John D. Archbold,
George A. Archer,
James Armstrong,
Francis B. Arnold,
Dr. Edmund S. F. Arnold,
John Aspinwall,
Theo. Aub,
Hugh D. Auchincloss,
Mrs. H. D. Auchincloss,
John W. Auchincloss,
Samuel P. Avery, Jr.,
Mrs. Elizabeth Bache,
Marshal L. Bacon,
Miss H. B. Bailey,
Frederic Baker,
Stephen Baker,
Robert F. Ballantine,
Theodore M. Banta,
Goldsborough Banyer,
Amzi Lorenzo Barber,

Henry I. Barbey,
Wm. D. Barbour,
Henry H. Barnard,
E. W. Barnes,
John S. Barnes,
Chas. T. Barney,
William Barr,
E. W. Bass,
Chas. Batchelor,
Thos. H. Bauchle,
Wm. N. E. Baylis,
Alfred N. Beadleston,
Gerard Beekman,
M. H. Beers,
August Belmont,
Perry Belmont,
James H. Benedict,
L. L. Benedict,
M. W. Benjamin,
Jno. R. Bennett,
Frank S. Benson,
Mrs. Adolph Bernheimer,
Chas L. Bernheimer,
Simon E. Bernheimer,
Edward J. Berwind,
Henry Beste,
Albert S. Bickmore,
Eugene P. Bicknell,
L. Horatio Biglow,
Isaac Bijur,
Miss Elizabeth Billings,
Miss Laura Billings,
W. H. Birchall,
Heber R. Bishop,
Geo. Blagden,
Mrs. Birdseye Blakeman,
Mrs. S. A. Blatchford,
Cornelius N. Bliss,
Ernest C. Bliss,
Mrs. Wm. T. Blodgett,
Jno. H. Bloodgood,
Lyman G. Bloomingdale,
Mrs. Edward C. Bodman,
Henry W. Boettger,
Albert G. Bogert,
Frank S. Bond,
Wm. E. Bond,
G. F. Bonner,
Hon. H. W. Bookstaver,
Simon Borg,
Frederick G. Bourne,
Temple Bowdoin,
John M. Bowers,
Anthony M. Brady,
J. Bramwell,
Michael Brennan,
Miss Cornelia G. Brett,
Mrs. Benjamin Brewster,
Jno. I. Bristol,
Mrs. Harriet Lord Britton,
Mrs. Kate M. Brookfield,
Edwin H. Brown,
John Crosby Brown,
M. Bayard Brown,
Robert I. Brown,
W. L. Brown,
W. P. Brown,
F. W. Bruggerhof,
H. B. Brundrett,
Carroll Bryce,
William Bryce, Jr.,
Mrs. William Bryce,
W. Buchanan,
Albert Buchman,
James Buckhout,
Mrs. J. Bunzl,
H. K. Burrac,
Thomas C. Bushnell,
Wm. Allen Butler,
Miss Helen C. Butler,

Wm. H. Butler,
Dr. John Cabot,
John L. Cadwalader,
H. A. Caesar,
S. R. Callaway,
Albert Calman,
Emil Calman,
Henry L. Calman,
W. L. Cameron,
H. H. Cammann,
Henry L. Cammann,
Thomas M. Carnegie,
G. M. Carnochan,
Mrs. Miles B. Carpenter,
A. Carter,
James C. Carter,
Walter S. Carter,
John W. Castree,
John H. Caswell,
Dr. W. H. Caswell,
Miss Jennie R. Cathcart,
Prof. J. McK. Cattell,
H. T. Cary,
Robert Caterson,
Frank R. Chambers,
J. E. Childs,
H. P. Chilton,
Geo. E. Chisholm,
Mrs. Wm. E. Chisolm,
Jared Chittenden,
Wm. G. Choate,
W. F. Chrystie,
Miss Helen L. Chubb,
John K. Cilley,
John Claflin,
J. Mitchell Clark,
Wm. N. Clark,
C. C. Clarke,
Dr. Wm. J. Coates,
Hon. W. Bourke Cochran,
John W. Cochrane,
Miss Mary F. Cockcroft,
C. A. Coffin,
Edmund Coffin,
E. W. Coggeshall,
Samuel M. Cohen,
N. A. Colburn,
Mrs. James B. Colgate,
Mrs. George Whitfield Collard,
P. F. Collier,
T. Collingwood,
Miss Ellen Collins,
Alexander T. Compton,
T. G. Condon,
Roland R. Conklin,
A. W. Conover,
Wm. L. Conyngham,
C. T. Cook,
Mrs. C. T. Cook,
Henry H. Cook,
Hon. Edward Cooper,
Geo. Coppell,
G. M. Corning,
John Cotter,
Chas. J. Coulter,
Clarkson Cowl,
Albert Crane,
Geo. F. Crane,
Jonathan Crane,
Mrs. Jonathan Crane,
J. P. Cranford,
Francis Crawford,
Robert L. Crawford,
Dr. W. H. Crawford,
H. G. Crickmore,
John D. Crimmins,
Geo. A. Crocker,
Frederic Cromwell,
Jas. W. Cromwell,
R. J. Cross,

Edwin A. Cruikshank,
Chas. Curie,
Chas. B. Curtis,
R. Fulton Cutting,
W. Bayard Cutting,
C. H. Dale,
Henry Dalley,
Ira Davenport,
J. Clarence Davies,
Wm. Gilbert Davies,
Clarence S. Day,
H. de Coppet,
Richard Deeves,
Geo. B. de Forest,
Robert W. de Forest,
B. F. De Klyn,
Dr. D. Bryson Delavan,
Charles de Rham,
Theo. J. de Sabla,
Theo. L. De Vinne,
F. W. Devoe,
Henry Dexter,
Anthony Dey,
W. B. Dickerman,
Chas D. Dickey,
Geo. H. Diehl,
Chas. F. Dieterich,
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Rev. Morgan Dix,
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D. Stuart Dodge,
Geo. E. Dodge,
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C. W. Doherty,
L. F. Dommerich,
Mrs. Henry Dormitzer,
Henry Dorscher,
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James Douglass,
Mrs. David Dows,
Mrs. David Dows, Jr.,
Tracy Dows,
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B. Ferdinand Drakenfeld,
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John Duer,
John P. Duncan,
Dr. Edward K. Dunham,
George H. Dunham,
E. B. Dunne,
James Dunne,
S. Whitney Dunscomb, Jr.,
Frank J. Dupignac,
H. A. Dupont,
John S. Durand,
J. B. Dutcher,
Thomas Dwyer,
D. Edgar,
Miss Laura J. Edwards,
Edward Ehrlich,
Henry G. Eilshemins,
August Eimer,
Emanuel Einstein,
Mrs. Matilda A. Elder,
Roswell Eldridge,
Geo. W. Ellis,
John W. Ellis,
J. M. Ellsworth,
Wm. Ellsworth,
Wm. W. Ellsworth,
John J. Emery,
C. Temple Emmet,
Robert Temple Emmet,
Robert Endicott,
Jno. C. Eno,
R. Erbsloh,
Louis Ettlinger,

Richard Evans,
H. C. Fahnestock,
Thos. H. Faile,
Chas. S. Fairchild,
Samuel W. Fairchild,
Geo. W. Fanning,
Jas. C. Fargo,
Henry W. Farnam,
John Armstrong Faust,
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B. Fischer,
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Jeremiah Fitzpatrick,
Wm. L. Flanagan,
Isaac D. Fletcher,
Miss Helena Flint,
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Scott Foster,
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H. P. Frothingham,
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Mrs. Martha F. Gay,
S. J. Geoghegan,
John J. Gibbons,
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R. W. Gibson,
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J. Waldron Gillespie,
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Chas. H. Godfrey,
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Samuel Goodman,
E. Read Goodridge,
Mrs. Frederic Goodridge,
Rev. Francis Goodwin,
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Edwin Gould,
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Robert D. Graham,
Henry Graves,
John Clinton Gray,
Ernest F. Graeff,
John Greenough,
Isaac J. Greenwood,
Rev. David H. Greer,
Daniel J. Griffith,
E. Morgan Grinnell,
Chester Griswold,
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W. S. Gurnee, Jr.,
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John A. Hadden, Jr.,
J. and M. Haffen,
James D. Hague,
Hon. Ernest Hall,
Miss Laura P. Halsted,
Wm. Hamann,
Miss Adelaide Hamilton,
Chas. T. Harbeck,
J. Montgomery Hare,
E. H. Harriman,
S. W. Harriot,
Wm. Hamilton Harris,
Mrs. Wm. Hamilton Harris,
Marcellus Hartley,
Jacob Hasslacher,
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J. C. Havemeyer,
T. A. Havemeyer,
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J. Woodward Haven,
E. Hawley,
R. Somers Hayes,

Frederick W. Haynes,
Arthur H. Hearn,
Wm. W. Heaton,
John G. Heckscher,
L. A. Heinsheimer,
Homer Heminway,
Chas. R. Henderson,
Chas. Henderson & Son,
Edmund Hendricks,
Samuel Henshaw,
Selmar Hess,
Hon. Abram S. Hewitt,
James J. Higginson,
Geo. R. Hill,
Wm. K. Hinman,
Dr. John H. Hinton,
B. Hochschild,
Mrs. Richard M. Hoe,
Richard M. Hoe,
Mrs. Robert Hoe,
John Swift Holbrook,
E. B. Holden,
E. R. Holden,
Miss Virginia Hollins,
Henry Holt,
Isaac A. Hopper,
William W. Hoppin,
Wm. P. Howe,
Alfred M. Hoyt,
Gerald L. Hoyt,
Samuel N. Hoyt,
Gen. Thos. H. Hubbard,
Alex. C. Humphreys,
Dr. Frederick Humphreys,
Edward T. Hunt,
Mrs. Robert P. Huntington,
Adolph G. Hupfel,
Frank Hustace,
John S. Huyler,
Clarence M. Hyde,
Frederick E. Hyde, Jr.,
Henry Iden, Jr.
Mrs. Samuel Inslee,
John B. Ireland,
A. D. Irving,
Adrian Iselin, Jr.,
C. Oliver Iselin,
Miss Georgine Iselin,
William E. Iselin,
Miss Flora Isham,
Samuel Isham,
Wm. B. Isham,
Chas. Carroll Jackson,
Frederic Wendell Jackson,
Dr. Abram Jacobi,
Robert Jaffray,
A. C. James,
D. Willis James,
Dr. Robert C. James,
Samuel M. Jarvis,
O. G. Jennings,
Walter Jennings,
James R. Jesup,
Adrian H. Joline,
Mrs. John D. Jones,
Jos. L. Kahle,
O. H. Kahn,
S. Nicholson Kane,
Mrs. H. F. Kean,
Mrs. A. B. Kellogg,
Mrs. Chas: Kellogg,
Thos. H. Kelly,
Edward Kemp,
Prof. J. F. Kemp,
H. Van Rensselaer Kennedy,
Mrs. Elizabeth C. Kenyon,
Rudolph Keppler,
Mrs. Catherine L. Kernochan,
John B. Kerr,
Geo. A. Kessler,

A. P. Ketchum,
Wm. Kevan,
Samuel K. Keyser,
S. E. Kilner,
Alfred R. Kimball,
David H. King, Jr.,
William F. King,
Wm. M. Kingsland,
Gustave E. Kissel,
Herman Knapp,
Shepherd Knapp,
Chas. Kohlman,
Wm. Krafft,
Julius G. Kugelman,
Percival Kühne,
H. R. Kunhardt, Jr.,
Adolf Kuttroff,
William M. Laffan,
Francis G. Landon,
Woodbury Langdon,
J. D. Lange,
J. Langeloth,
Lewis H. Lapham,
Richard Lathers,
Walter W. Law,
John Burling Lawrence,
Mrs. Lydia G. Lawrence,
Richard H. Lawrence,
Mrs. Samuel Lawrence,
W. V. Lawrence,
J. D. Layng,
Chas. N. Lee,
Prof. Frederick S. Lee,
Wm. H. Lefferts,
Emanuel Lehman,
Edward A. Le Roy, Jr.,
Arthur L. Lesher,
Julius Levine,
Mrs. John V. B. Lewis,
Leonard Lewisohn,
Philip Lewisohn,
Wm. S. Livingston,
Wm. C. Lobenstine,
Luke A. Lockwood,
James Loeb,
Prof. Morris Loeb,
Walter S. Logan,
Mr. Daniel D. Lord,
Franklin B. Lord,
R. P. Lounsberry,
Adolph C. Low,
Mrs. Chas. Russell Lowell,
Chas. H. Ludington,
August Lueder,
Walther Luttgen,
Samuel H. Lyman,
Mrs. Alida McAlan,
C. W. McAlpin,
Geo. L. McAlpin,
John A. McCall,
Mrs. W. H. McCord,
Thos. A. McIntyre,
Gilbert H. McKibbon,
Rev. Haslett McKim,
Geo. William McLanahan,
James McLean,
Geo. R. MacDougall,
W. W. MacFarland,
J. W. Mack,
D. E. Mackenzie,
Malcolm MacMartin,
Chas. A. Macy, Jr.,
Chas. A. Macy, 2d,
V. Everit Macy,
J. H. Maghee,
Alexander Maitland,
Chas. Mallory,
Howard Mansfield,
Miss Delia W. Marble,
Theophilus M. Marc,

A. Marcus,
Peter Marie,
Jacob Mark,
T. M. Markoe,
Henry S. Marlor,
Henry G. Marquand,
Chas. M. Marsh,
Chas. H. Marshall,
Louis Marshall,
Edwin S. Marston,
W. R. H. Martin,
Brander Matthews,
Robert Maxwell,
David Mayer,
Harry Mayer,
Mrs. Emma Mehler,
Payson Merrill,
Capt. Henry Metcalfe,
Dr. Alfred Meyer,
J. Meyer,
Thos. C. Meyer,
Dr. Geo. N. Miller,
Jacob F. Miller,
S. M. Milliken,
W. McMaster Mills,
Peter Moller,
A. C. Monson,
Alphonse Montant,
Francis C. Moore,
Wm. H. Helme Moore,
Mrs. Daniel Moran,
E. D. Morgan,
Geo. H. Morgan,
A. H. Morris,
A. Newbold Morris,
Mrs. Cora Morris,
Miss Eva V. C. Morris,
Henry Lewis Morris,
Louis R. Morris,
Geo. Austin Morrison,
Richard Mortimer,
Robt. I. Murray,
Nathaniel Myers,
Adam Neidlinger,
Edward M. Neill,
Wm. Nelson,
Geo. G. Nevers,
Miss Catherine A. Newbold,
Miss Edith Newbold,
Frederic R. Newbold,
Geo. L. Nichols,
John Barron Niles,
Wm. Nilsson,
John Notman,
Frederick J. Nott,
Adolph Obrig,
E. E. Olcott,
Robert Olyphant,
Hugh O'Neill,
Mrs. Emerson Opdycke,
Wm. S. Opdyke,
Adolphe Openhym,
Mrs. Wm. Openhym,
William C. Orr,
Prof. Henry S. Osborn,
Mrs. W. H. Osborn,
Wm. Church Osborn,
Lowell M. Palmer,
N. F. Palmer,
S. S. Palmer,
Henry Parish,
Henry Parish, Jr.,
John H. Parker,
Henry V. Parsell,
Mrs. Phebe A. Parshall,
Charles Parsons,
Mrs. Edwin Parsons,
John E. Parsons,
W. A. Paton,
O. H. Payne,

Mrs. Frederick Pearson,
Miss Frances Pell,
Wm. Hall Penfold,
Geo. H. Penniman,
Geo. W. Perkins,
Samuel T. Peters,
W. R. Peters,
Lloyd Phoenix,
Phillips Phoenix,
Gottfried Piel,
Winlsow S. Pierce,
Gifford Pinchot,
James W. Pinchot,
Fred S. Pinkus,
Hon. Thos. C. Platt,
Gilbert M. Plympton,
Henry W. Poor,
A. S. Post,
C. A. Postley,
Frederick Potter,
Miss M. Potter,
De Veaux Powel,
Anderson Price,
Chas. Pryer,
Percy R. Pyne,
Charles Raht,
Gustav Ramsperger,
Geo. Curtis Rand,
Geo. R. Read,
Wm. A. Read,
G. H. Redmond,
Whitelaw Reid,
Geo. A. Reinhardt,
John B. Reynolds,
Miss Serena Rhinelander,
John Harsen Rhoades,
Prof. Charles Rice,
Auguste Richard,
Prof. P. de P. Ricketts,
John L. Riker,
Samuel Riker,
H. Dillon Ripley,
Dr. Wm. C. Rives,
S. H. Robbins,
Miss Mary M. Roberts,
Andrew J. Robinson,
Frederick Rode,
J. C. Rodgers,
Edward L. Rogers,
Noah C. Rogers,
Theo. Rogers,
W. Emlen Roosevelt,
Mrs. W. Emlen Roosevelt,
Hon. Elihu Root,
E. V. W. Rossiter,
Jacob Rothschild,
Wm. Rothschild,
George P. Rowell,
Charles Runyon,
Jacob Ruppert,
Mrs. A. D. Russell,
Chas. H. Russell,
Clarence Sackett,
Henry W. Sackett,
Mrs. Edward C. Sampson,
C. Daniel Sands,
Carl Schefer,
Miss Mary E. Schell,
J. Egmont Schermerhorn,
Mrs. H. M. Schieffelin,
Dr. Wm. Jay Schieffelin,
Jacob H. Schiff,
Gustave Schirmer,
Rudolph E. Schirmer,
Grant B. Schley,
Miss Jane E. Schmelzel,
Henry W. Schmidt,
Paul G. Schoeder,
C. Schumacher,
Philip Schuyler,

L. Henry Schwarz,
Adolph Schwarzmann,
Mrs. James Scott,
Edward M. Scudder,
Geo. J. Seabury,
Wm. T. Sebert,
Mrs. Horace See,
George W. Seligman,
T. G. Sellew,
Alfred Seton, Jr.,
Miss Clarence Seward,
Miss Angelica B. Shea,
W. H. Sheehy,
Edward M. Shepard,
G. K. Sheriden,
Gardiner Sherman,
G. O. Shields,
Robt. Simon,
John W. Simpson,
W. T. Simpson,
John Sinclair,
Samuel T. Skidmore,
Francis Louis Slade,
Albert K. Smiley,
Daniel Smiley,
Chas. F. Smillie,
James D. Smillie,
Mrs. Annie Morrill Smith,
Chas. Robinson Smith,
Edward A. Smith,
George W. Smith,
James H. Smith,
James R. Smith,
Walter M. Smith,
Wm. Alex. Smith,
Chas. Sooysmith,
A. W. Soper,
Frederick Southack,
Samuel Spencer,
Paul N. Spofford,
Miss Anna Riker Spring,
Dr. Edward H. Squibb,
J. R. Stanton,
John Stanton,
Jno. N. Stearns,
James H. Stebbins,
Henry Steers,
James R. Steers,
Benjamin Stern,
Isaac Stern,
Louis Stern,
Olin J. Stephens,
Alexander H. Stevens,
Dr. Geo. T. Stevens,
Lispenard Stewart,
Wm. R. Stewart,
Jos. Stickney,
Miss Clara F. Stillman,
Dr. D. M. Stimson,
James Stokes,
Mrs. J. O. Stone,
Mason A. Stone,
Sumner R. Stone,
Chas. Strauss,
Edward Sturges,
F. K. Sturgis,
Thos. Sturgis,
Rutherford Stuyvesant,
Mrs. George Such,
Miss Catharine A. Sullivan,
Mrs. P. C. Swords,
Albert Tag,
Edward N. Tailer,
C. A. Tatum,
Miss Alexandrina Taylor,
Geo. C. Taylor,
Stevenson Taylor,
Wm. E. Tefft,
C. H. Tenney,
H. L. Terrell,

Jno. T. Terry,
Nikola Tesla,
Ernst Thalmann,
Anthony J. Thomas,
Samuel Thomas,
L. S. Thompson,
Dr. W. Gilman Thompson,
Walter Thompson,
Mrs. Phebe Anna Thorne,
Samuel Thorne, Jr.,
William Thorne,
W. V. S. Thorne,
H. L. Thornell,
C. C. Tiffany,
C. L. Tiffany,
Louis C. Tiffany,
E. Titus, Jr.,
J. Kennedy Tod,
William Toel,
William Toothe,
Henry R. Towne,
R. H. L. Townsend,
R. W. Townsend,
C. D. Tows,
J. Evarts Tracy,
Edwin D. Trowbridge,
Frederick K. Trowbridge,
Dr. Alfred Tuckerman,
Paul Tuckerman,
Edward P. Tyson,
Geo. E. Turnure,
Benjamin Tuska,
E. S. Ullman,
Miss Anna Murray Vail,
Herbert Valentine,
Mrs. Lawsen Valentine,
Chas. H. Van Brunt,
Cornelius Van Brunt,
Augustus Van Cortlandt,
E. H. Van Ingen,
W. Van Norden,
Alfred Van Santvoord,
Joseph H. Van Vleeck,
Edgar B. Van Winkle,
Miss Elizabeth Van Winkle,
Herman Vogel,
H. A. Von Post,
John Wagner,
Hon. Salem H. Wales,
Lewis Wallace,
Antony Wallach,
Wm. I. Walters,
E. A. Walton,
Wm. T. Wardwell,
Allan C. Washington,
Miss Emily A. Watson,
Mrs. John A. Weekes,
Chas. Wehrhane,
Camille Weidenfeld,
Mrs. Chas. G. Weir,
Mrs. John Wells,
R. E. Westcott,
Geo. Westinghouse,
Dr. Jno. McE. Wetmore,
Dr. Geo. G. Wheelock,
Dr. Wm. E. Wheelock,
Miss Caroline Wight,
Horace White,
A. H. White,
Stanford White,
Dr. Whitman V. White,
J. Henry Whitehouse,
Worthington Whitehouse,
James Whiteley,
Giles Whiting,
Clarence Whitman,
Wm. Wicke,
Edward A. Wickes,
Robt. F. Wilkinson,
Franklin A. Wilcox,

David Willcox,
John T. Willetts,
Robt. R. Willets,
G. G. Williams,
Richard H. Williams,
Mrs. Douw D. Williamson,
Washington Wilson,
William G. Wilson,
Dr. Joseph E. Winters,
Egerton Winthrop,
Grenville L. Winthrop,
Mrs. Frank S. Witherbee,
Ernst G. W. Woerz,
Emil Wolff,
Louis S. Wolff,
Mrs. Cynthia A. Wood,
James Wood,
Wm. Congdon Wood,
John A. Woods,
F. F. Woodward,
Prof. R. S. Woodward,
W. H. Woolverton,
Miss Julia Wray,
Mrs. J. Hood Wright,
C. S. Young,
Edw. L. Young,
Andrew C. Zabriskie,
August Zinsser,
O. F. Zollikoffer,

REPORT OF THE TREASURER.

NEW YORK, JANUARY 13, 1902.

TO THE BOARD OF MANAGERS OF
THE NEW YORK BOTANICAL GARDEN.

Gentlemen:

Herewith I submit a statement of my Receipts and Disbursements during the year 1901 and a Balance Sheet from my Ledger as of December 31, 1901.

Respectfully yours,
C. F. COX, *Treasurer.*

Receipts.

Balance as per last Annual Report..........		$ 7,417.04
Appropriations of the City for Construction and Maintenance.....................		65,924.27
Income from Investments:		
Accrued interest on N. Y. City Bonds sold...$	1,676.96	
5 per cent. on $50,000 Southern Railway Genl. Mtge. Bonds..............	2,500.00	
4½ per cent. on $50,000 Ches. & Ohio R. R. Genl. Mtge. Bonds.....	2,250.00	
4 per cent. on $50,000 Erie R. R. Prior Lien Bonds......................	2,000.00	
4 per cent. for one-half year on $50,000 Erie R. R., Penna. Collat. Trust Bonds..........................	1,000.00	
4 per cent. for one-half year on $50,000 Reading R. R., Jersey Cent. Collat. Trust Bonds..................	1,000,00	
4 per cent. for one-half year on $24,000 Northern Pac., St. Paul & Duluth Div. Bonds.........................	480.00	
4 per cent. for one-half year on $14,000 N. P., Great Northern, C. B. &. Q. Collat. Trust Bonds..........	280.00	
	11,186.96	
Less accrued interest paid on bonds purchased	1,012.89	10,174.07

Annual Dues		8,470.00
Interest @ 3 per cent. allowed by J. P. Morgan & Co. on balances on deposit		438.61
Proceeds hay sold		17.50
Proceeds publications		94.58
Life Membership Fees		1,500.00
Tuition Fees, credited Students' Research Fund		328.75
Contributions to Conservatory Fund		25.00
Contributions to Exploration Fund		2,050.00
Contributions to Museum and Herbarium Fund		1,550.00
Contributions to Special Book Fund		1,825.00
Contribution of Olivia E. P. Stokes and Caroline Phelps Stokes to fund for Preservation of Native Flora		3,000.00
On account of Bequest of Hon. Charles P. Daly		20,465.18
Proceeds of $60,000 N. Y. City Bonds sold at 100	$60,000	
Proceeds of $50,000 N. Y. City Bonds sold at 99	49,500	109,500.00
		$232,780.00

Disbursements.

Addition to Director-in-Chief's Working Fund	2,500.00
Expenses paid through Director-in-Chief:	
Ac. City Appropiations	65,924.27
On General Account, for Vouchers paid	16,890.93
Books—account Special Book Fund	1,435.56
Plants—account Conservatory Fund	1,604.80
Specimens—account Exploration Fund	1,837.71
do account Museum and Herbarium Fund	150.00
Investments:	
$50,000 Erie R. R. Penn. Collat. Trust 4 % Bonds, @ 92½	46,250.00
$9,000 Erie R. R. Penn. Collat. Trust 4 % Bonds, @ 95¼	8,463.75

$24,000 Nor. Pacific, St. Paul and Duluth Division 4 % Bonds @ 100¼	24,060.00	
$50,000 Reading R. R. Jersey Cent. Collat. Trust 4 % Bonds @ 93½	46,750.00	
$14,000 Northern Pacific-Gt. Northern C. B. & Q. Collat. Trust 4 % Bonds @ 96½	13,387.50	229,254.52
Balance, Cash on hand		$3,525.48

LEDGER BALANCES, DECEMBER 31, 1901.

Credit.

Permanent Funds:	
Endowment Fund	$264,750.00
Fellowship Fees	8,000.00
Life Membership Fees	10,100.00
Students' Research Fund	1,108.48
Chas. P. Daly Bequest	20,465.18
Stokes Fund	3,000.00
Temporary Funds:	
For Library Books	1,179.08
For Conservatory Plants	38.13
For Exploration	212.29
For Museum and Herbarium Specimens	1,400.00

Debit.

Investments:

Net Cost of $50,000 Ches. & Ohio Ry. Co. Genl. Mtge. Bonds	$287,660.01
$50,000 Southern Ry. Co. 1st Consol. Mtge. Bonds	
$50,000 Erie R. R. Co. Prior Lien Bonds	
$59,000 Erie R. R. Penn. Coll. Trust Bonds	
$50,000 Reading R. R. Co. Jersey Cent. Coll. Trust Bonds	
$24,000 N. Pacific R. R. Co. St. Paul and Duluth Div. Bonds	
$14,000 N. Pacific-Gt. Northern C. B. & Q. Coll. Trust Bonds	

Director-in-chief, Working Fund............	10,000.00	
Construction Account, Cost of Plans not yet used.................................	2,350.00	
Income Account, balance borrowed from Permanent Funds.............................	6,717.67	
Cash in Bank...	3,525.48	
	$310,253.16	$310,253.16

FEBRUARY 14TH, 1902.

DR. N. L. BRITTON, *Director-in-Chief*,
New York Botanical Garden,
Bronx Park, New York City.

Dear Sir: In response to your letter of the 16th of January last, and at the request of the Board of Managers, I have caused the accounts of the Treasurer of the New York Botanical Garden, for the year 1901, to be examined and audited, and take pleasure in reporting that the same have been found to be correct, in accordance with the Balance Sheet and Statement of Receipts and Disbursements, returned herewith, with the Auditor's Certificate.

Yours very truly,
JAMES A. SCRYMSER,
Chairman, Finance Committee.

BOTANICAL CONTRIBUTIONS.

Mycological Studies. I.

By F. S. Earle.

1. Ascocorticium in North America.

In 1881 * Ellis and Harkness described under the name o *Ascomyces anomalus* a fungus with naked asci forming white spots on fallen pine bark. In 1889 Saccardo † transferred this species to the genus *Exoascus*. In 1881, Brefeld ‡ published *Ascocorticium albidum* as a new genus and species.

An examination of the material in the herbarium here shows Ellis' and Brefeld's species to be identical. The genus *Ascocorticium* is well founded as it is sufficiently distinct from *Exoascus* to be considered the type of a different family, but the earlier specific name will evidently have to be retained. The name and synonomy of the species will, therefore, be as follows:

Ascocorticium anomalum (Ell. & Hark.).

Ascomyces anomalus Ell. & Hark. *loc. cit.* (1881).

Exoascus anomalus Sacc. *loc. cit.* (1889).

Ascocorticium albidum Brefeld. *loc. cit.* (1891).

Exsic.: Ellis N. A. Fungi, no. 561, Rehm, Ascomyceten, no. 1102.

Icones: Brefeld, Untersuchungen, **9**: *pl. 1. figs. 37–39.*

2. A Synopsis of the North American Species of Periconia.

The genus *Periconia* of the Dematiaceae has had a rather checkered history. Nearly all the species now referred to it have at one time or another been called *Sporocybe*, while many of the species formerly known by this name must now be sought for under *Sporocybe*, *Stachybotrys*, *Haplophragmium* or *Graphium*. *Periconia* was first described and

* Bull. Torrey Club, **8**: 26

† Sylloge Fungorum, **8**: 82.

‡ Untersuchungen über Schimmelpilze, **9**: 145.

figured by Tode * in 1791, but it was defined in its modern sense by Bonardin † in 1851. It includes those dematiaceous fungi having erect, simple, usually septate conidiophores bearing simple conidia in a somewhat compact head at the more or less enlarged apex, without special basidia.

The North American species may be distinguished by the following synopsis:

KEY TO THE NORTH AMERICAN SPECIES OF PERICONIA.

1.	Conidia globose, brown.	2.
	Conidia ovate, oblong, etc.	10.
2.	Conidia roughened, echinulate, etc.	3.
	Conidia nearly or quite smooth.	8.
3.	Conidiophores densely gregarious, forming velvety areas, substratum blackened.	4.
	Conidiophores scattered, substratum not blackened.	7.
4.	Conidia large, 10 μ or more.	5.
	Conidia small, less than 10 μ.	6.
5.	Capitulum apical.	1. *P. byssoides.*
	Capitulum lateral (near the apex).	2. *P. lateralis.*
6.	Conidiophores unbranched, rough, on woody twigs, etc.	3. *P. commonsii.*
	Conidiophores occasionally branched above, smooth, shining, on grasses and sedges, etc.	4. *P. nigriceps.*
7.	Conidiophores 400–500 μ, conidia 10–14 μ.	5. *P. epiphylla.*
	Conidiophores 150–300 μ, conidia 16–18 μ.	6. *P. Palmeri.*
8.	Conidia large, 8–10 μ.	7. *P. opaca.*
	Conidia small, 2–3 μ.	9.
9.	Conidiophores fascicled, conidia agglutinate.	8. *P. Langloisii.*
	Conidiophores not fascicled, conidia separating.	9. *P. tenuissima.*
10.	Conidia colorless, 8–15 μ long.	10. *P. albiceps.*
	Conidia yellowish, minute, spermatoid.	11. *P. abietina.*

1. PERICONIA BYSSOIDES Pers. Syn. Fung. 686. 1801.

Sporocybe byssoides Fr. Syst. Myc. **3**: 343. 1829.

Periconia pycnospora Fresenius, Beiträge zur Myk. **20**: *pl. 4. f. 1.* 1850.

Widely effused over blackened areas; conidiophores gregarious, erect, fuscous, often somewhat curved and lighter or subhyaline above, sparingly septate, tapering upwards, ½–1 mm. long, about 17 μ thick at base, tapering to about

* Fungi Mecklenbergensis Selecti Fasc. 2: 2. 1791.

† Handbuch der Allgemeinen Mykologie, 112. 1851.

12 μ at apex; capitulum compact, subglobose, apical, about 50 μ; conidia globose, sharply echinulate, 12–15 μ.

On dead stems of various berbaceous exogens, very common throughout Europe and North America.

Persoon's description is not sufficient to fully identify his species, but the material usually referred to it can not be distinguished from the better described and well figured *P. pycnospora* Fresen. The very abundance of the species argues in favor of its being the one in Persoon's hands.

2. PERICONIA LATERALIS El. & Ev. Jour. Myc. **2**: 104. 1886.

Widely effused over blackened areas; conidiophores gregarious, erect, subulate, opake, septate, nearly straight, 250–300 μ high, 8–10 μ thick at base; capitulum lateral, borne just below the tip of the conidiophore, flattened; conidia globose, yellowish brown, echinulate, nucleate, 10–12 μ.

On dead stems of grasses, Louisiana (Langlois). By a strict construction this species would be excluded from *Periconia* on account of its lateral capitulum. The entire group is in need of further study with more abundant and fresher material. Until this is possible it seems best not to increase the number of generic names.

3. **Periconia Commonsii** sp. nov.

Blackening the substratum over considerable areas; conidiophores densely gregarious, larger below and tapering upwards but not distinctly bulbous, obscurely 1–3-septate, roughened by adhering conidia, brown throughout, 150–300 μ long, about 14 μ wide at base, 7 μ at apex; capitulum globular, terminal, 35–40 μ; conidia globular, light brown, minutely and sparingly echinulate, 6–7 μ.

On decorticated area on dead limb of *Morus*, Delaware, Aug., 1889, Commons no. 939 (in herb. Ellis).

This specimen was labeled *Periconia minutissima* Corda? In that species as shown by Corda Icones, **1**: *pl. 5, f. 259*, the apex of the conidiophore is more or less branched, and there are basidia differing in shape from the conidia. This would exclude it from *Periconia* as here understood, but this

specimen seems to be entirely typical of the genus. The description as given above agrees closely with the next following species but the substrata are very different and there are other differences hard to define exactly.

4. PERICONIA NIGRICEPS (Peck) Sacc. Syll. **4**: 274. 1886.
Sporocybe nigriceps Peck, Reg. Rep. **34**: 49. 1883.

Blackening the substratum; conidiophores gregarious, erect, smooth, shining, septate, sometimes with one or two short thick branches near the top, not exceeding 500 μ; capitulum globose or elliptical; conidia brownish, globose, minutely roughened, 6–8 μ.

On dead stems of sedges and grasses. New York. I also refer here somewhat doubtfully Common's no. 2361 on *Scirpus lacustris*, from Delaware, Langlois, no. 919 on *Spartina polystachya* from Louisiana, and two specimens on corn stalks collected in New Jersey by Mr. Ellis.

5. PERICONIA EPIPHYLLA Schw. Trans. Am. Phil. Soc. (Syn. Fung. Amer.), **4**: 304. 1834.

Sporocybe epiphylla Sacc. Syll. **4**: 608. 1886.

Not blackening the substratum; conidiophores scattered, nearly cylindrical or slightly tapering upward, often flexed, 2–4-septate, brown, 400–500 $\times$ 14 μ; capitulum nearly spherical, about 40 μ; conidia globose, brown, echinulate, about 10–14 μ.

On more or less definite areas on dead leaves. I refer here a specimen on leaf-miner spots on *Smilax*, from New Jersey (Ellis), and on *Ailanthus* leaves, locality and collector not stated.

The taking up of von Schweinitz's name for this species is perhaps hardly warranted by his description which is as follows:

"3047. P. epiphylla L.v.S., in variis foliis dejectis observata, Bethl. P. sparsa, pluribus tamen approximatis. Sporodochio breviusculo, superne attenuate, nigro. Capitulo pro ratione magno, fusco, globoso. Sporidiis nigris, densein inspersis."

There is certainly nothing here to justify the wholesale transference of this and others of von Schweinitz's species to *Sporocybe* as is done by Saccardo in Sylloge Fungorum.

The species is near *P. byssoides*, but may be distinguished by the scattered and shorter, less tapering, conidiophores and by the fact that the substratum is not blackened.

6. **Periconia Palmeri** sp. nov.

Substratum not blackened; conidiophores few, scattered, rather short and stout, dark brown, opake, continuous or once or twice obscurely septate, slightly tapering upwards, 150–300 μ high, 18 μ wide at the base; capitulum large, oblately flattened, 60–70 × 80–100 μ. Conidia globose, brown, tuberculate, 16–18 μ.

On dead hanging twigs and leaves of *Juniperus Virginiana*, Stanford, Conn., October 27, 1901, Mr. L. M. Palmer.

A very distinct species well characterized by its large tuberculate (not echinulate) conidia and short, thick, scattered conidiophores. It is probably a saprophyte but it occurs in connection with a peculiar dying of the twigs of the common red cedar.

7. Periconia opaca Cooke, Grevillea, **16**: 79. 1888.

Conidiophores gregarious, erect, 3–4-septate, simple, dark brown, opake; capitulum subglobose, composed of 5 or 6 conidia; conidia globose, dark brown, opake, smooth with a minute apiculus below, 12–15 μ.

On leaves of carices, So. Car., Ravenel, no. 3140. Not seen by me.

8. **Periconia Langloisii** sp. nov.

Blackening the substratum over larger areas; conidiophores densely gregarious, cespitose, several from a common base, very slender, almost thread-like, occasionally septate, subpellucid, light brown, about 100 × 2½ μ. Capitulum small, globose, yellowish-brown, deciduous, composed of densely agglutinated conidia that are not readily separable, about 12–20 μ; conidia globose, smooth, light brown, translucent, about 2 μ.

On dead stems of *Andropogon*, Louisiana, Langlois, no. 1795.

This has been determined as *Periconia fusca* Corda? but that species has oblong spores. It is perhaps near the next following species but seems to be sufficiently distinguished by the fascicled conidiophores and densely agglutinated capitulum.

9. PERICONIA TENUISSIMA Peck, Reg. Rep. **46**: 33. 1893.

Effused, forming a thin indefinite purplish-brown stratum; conidiophores erect, slender, simple, scarcely septate, 300–350 × 4 μ; capitulum minute, globose; conidia globose, colored like but paler than the hyphae, 2½–3 μ.

On a thick stratum of mycelium of some wood inhabiting fungus. New York (Peck), Not seen by me.

10. PERICONIA (?) ALBICEPS Peck, Reg. Rep. **32**: 40. 1880.

(Figured Bull. N. Y. State Mus. $\mathbf{1}^2$: *pl. 1. f. 8–11.*)

Conidiophores short, equal or slightly tapering upward, black, ½–¾ mm.; capitulum white, subglobose; conidia oblong or subfusiform, colorless, 7½–15 μ long.

On dead stems of *Chelone glabra*, New York (Peck). The published figures of this species shows the conidia borne on elongated basidia which would exclude it from *Periconia* as here defined. Unfortunately the only specimen seen is not in good condition, and gives no light on the subject. In his earlier reports Peck followed Berkeley and Cooke in using the name *Periconia* for species with compound conidiophores, so it quite possibly belongs to the Stilbaceae, though there is nothing in the description or figure to indicate it. Saccardo did not transfer this species to *Sporocybe* as he did most of Peck's earlier species of *Periconia*.

11. PERICONIA ABIETINA (Peck) Sacc. Syll. **4**: 273. 1886.

Sporocybe abietina Peck, Reg. Rept. **31**: 45. 1879.

Very minute; condiophores slender, distinctly septate, nearly black; capitulum terminal, yellowish, obovate or subglobose; conidia minute, oblong, spermatoid.

On bark and wood of *Abies nigra*, New York (Peck), not seen by me, said to be about the size of *P. byssoides*.

Excluded Species.

The following species have at one time or another been referred to *Periconia*, but are now excluded:

Periconia alternata (Berk.) Sacc. So far as American material is concerned this is *Stachybotrys alternans* Bon.

Periconia azaleae Peck is *Sporocybe azaleae* (Peck) Sacc.

Periconia bulbosa Schw. is *Sporocybe bulbosa* (Schw.) Sacc.

Periconia calicioides (Fr.) Berk. is *Sporocybe calicioides* Fr.

Periconia corticalis C. & P. is *Sporocybe corticalis* (C. & P.) Sacc.

Periconia fasciculata Schw. is *Sporocybe fasciculata* (Schw.) Sacc.

Periconia gracilis Schw. is *Sporocybe gracilis* (Schw.) Sacc.

Periconia lichenosa Schw. is *Sporocybe macularis* (Schw.) Sacc.

Periconia macularis Schw. is *Sporocybe macularis* (Schw.) Sacc.

Periconia nana Lk. is *Graphium nanum* (Ehrh.) Sacc.

Periconia parasitica Peck is *Sporocybe parasitica* (Peck) Sacc.

Periconia persicae Schw. is *Cornularia persicae* (Schw.) Sacc.

Periconia robiniae Schw. is *Sporocybe robiniae* (Schw.) Fr.

Periconia sphaerophila Peck is *Sporocybe sphaerophila* (Peck) Sacc.

Periconia stemonites Schw. is *Graphium subulatum* (Nees) Sacc.

Periconia subulata Lk. is *Graphium subulatum* (Nees) Sacc.

Periconia truncata C. & P. is *Sporocybe truncata* (C. & P.) Sacc.

3. New Florida Fungi.

HELOTIACEAE

Hymenoscypha nigromaculata sp. nov.

Epiphyllous on jet black suborbicular spots ½–1 cm. in diameter; ascomata gregarious, brown, sessile or substipitate, margin inrolled, covering the brownish disc when dry, expanding to turbinate when moist, about ⅓ mm. broad and high, peridium of thin-walled, brownish, narrow, prosenchymatous threads about 3 μ thick, the margin roughened by the slightly swollen projecting ends of the threads; asci numerous, broadly clavate, about $70 \times 14 \mu$; paraphyses few, thread-like, but rather thick and substrict, ends not swollen; ascospores distichous or subinordinate, hyaline, irregularly oblong, continuous, $18–20 \times 6 \mu$.

On languishing leaves of *Iris* sp., Palmetto, Fla., Nov. 30, 1901, S. M. Tracy, no. 7299.

The specimens seem slightly immature. It is possible that the spores may develop septa at full maturity.

PERISPORIACEAE

Dimerosporium vestitum sp. nov.

Epiphyllous, forming a thin black widely effused coating; mycelium slender, pale brown, about 3–4 μ thick; conidia subglobose, sarcinella-like, usually 4-celled, opake, black, short-stalked, about 20 μ; perithecia dark brown, about 85–100 μ, wall-cells minute, close woven, densely clothed with depressed-spreading, brown hairs which are substraight at base, but variously flexed above, continuous or sparingly septate, $100–200 \times 4–5 \mu$; asci broadly clavate, $35–40 \times 8–10 \mu$; paraphyses abundant, thread-like; ascospores distichous or inordinate, narrowly ovate, unequally septate, hyaline, conspicuously 3-guttate, about $8 \times 3–4 \mu$.

On living leaves of *Baccharis glomeruliflora*, Manatee, Fla., Dec. 11, 1901, S. M. Tracy, no. 7279.

This is at once distinguished from other species of *Dimerosporium* on *Baccharis* by the abundant vestiture of long brown hairs. The conidial stage would easily pass for *Sarcinella heterospora* Sacc.

Melanconiaceae.

Colletotrichum cerei sp. nov.

Thickly scattered over considerable areas, without definite spots; ascervuli black, buried, long covered by the epidermis which is pierced by the slender bundle of setae, at length exposed by the falling away of the epidermal covering; setae few, usually centrally fascicled, black or dark brown, septate, irregularly tapering upward, about 70 μ long by 6–7 μ wide at base; sporules irregularly oblong, 18–22 × 6–7 μ, hymenial layer of dark, somewhat regular, parenchymatous cells 6–7 μ in diameter.

On dying *Cereus triangularis*, Sanibel Island, Fla., May 16, 1901, S. M. Tracy, no. 7309.

Dematiaceae.

Verticicladium effusum sp. nov.

Hypophyllous, forming widely effused, irregular, dark olivaceous areas; mycelium superficial, of pale brown, creeping, frequently septate threads, 3–3½ μ in diameter; conidiophores resembling the mycelium threads, erect, at first simple, at length sparingly branched about the middle, 75–150 × 3–3½ μ; conidia narrowly elliptic, hyaline, continuous, 8–10 × 3 μ.

On languishing leaves of *Coccoloba uvifera*, Sarasota Key, Fla., May 12, 1901, S. M. Tracy, no. 7316.

Sporoschisma Tracyi sp. nov.

Covering conspicuous gall-like swellings 1 cm. in diameter; conidiophores blackish-brown in mass, dark yellow under the microscope, densely floccose or subfascicled, suberect, variously flexed, 300–400 × 15 μ; conidia internal, escaping from the broken ends of the conidiophores (sporangia?), dark yellow, cylindrical, ends rounded, at first 2-septate, becoming several-septate, usually 35–40 × 14 μ, sometimes larger.

On dead twigs of *Ilex* sp., Sanibel Islands, Fla., May 16, 1901, S. M. Tracy, no. 7308.

This is a conspicuous addition to a small and poorly understood genus. It can hardly properly belong to the Dematiaceae when it is placed both by Saccardo in Sylloge Fungorum and by Lindau in Engler & Prantl, Pflanzfamilien. The

Vaucheria-like sporangia (?) suggest its algal relationship, but it seems to have no chlorophyll.

Tuberculariaceae.

Pucciniopsis caricae sp. nov.

Hypophyllous; spots suborbicular, thickened, 1–1½ mm. in diameter, discolored and marked by a circumscribing brown line above, black from the crowded sporodoches below; sporodoches black, orbicular, densely aggregated, becoming subconfluent, 50–100 μ; conidiophores densely crowded, clavate-cylindric, brown, continuous, 40–50 × 7–8 μ; conidia light fuscous, obovate to subelliptic, conspicuously roughened by short, blunt papillae, at first continuous, at maturity 1-septate, scarcely constricted, rounded above, narrowed below, 18–20 × 8–10 μ.

On languishing leaves of *Carica Papaya*, Sanibel Islands, Fla., May 18, 1901, S. M. Tracy, no. 7314.

4. New California Fungi.

Among a large and interesting lot of fungi collected by C. F. Baker at or near Stanford University, Calif., during the fall of 1901, the following seem to be new or noteworthy. Descriptions of the fleshy species are mostly taken from the very full and satisfactory field notes made by the collector.

Agaricaceae.

Russula cremoricolor sp. nov.

Among decaying oak leaves; pileus 6–10 cm., convex with the center often depressed, dark cream color, disc darker, smooth, viscid when young, margin incurved, entire; lamellae heterophyllous, subsinuate, subcrowded, broad, nearly plane, pale cream color; spores white, globose, sparingly echinulate, 5½–7 μ; stipe 4–6 × 2½–3½ cm., irregular, subequal, smooth, white, solid; flesh white, unchanging, very peppery, odor not noticeable.

Stanford University, Calif., Dec. 4, 1901, C. F. Baker, no. 137.

This somewhat resembles *R. mustelina* Fr., but differs in the white not pallid stipe and in the cream-colored, not white

lamellae. No measurements of that species are recorded, but as figured (Krombh. *pl. 61*, *f. 8, 9*) it is smaller and darker colored than our plant. It belongs to the section *Compactae*.

Russula paxilloides sp. nov.

In beds of decaying oak leaves; pileus 5–9 cm. thick and fleshy but with thin margin, expanded or subdepressed, disc whitish or pallid more or less deeply washed with carmine toward the margin, smooth, slightly viscid, margin entire; lamellae all equal, interveined and subanastomosing near the stipe, subsinuate, broad, subplane, white to cream yellow; spores pale yellow, globose, rough with sharp conical projections, 7–9 μ; stipe variable in size, 5–11 × 1½–3 cm., equal, smooth, white, spongy, stuffed with a loose pith; flesh white, unchanging, taste burning peppery, odor not noticeable.

Stanford University, Calif., Nov. 30, 1901, C. F. Baker, no. 156.

This showy species is somewhat nearly related to *R. veternosa* Fr. but it may be distinguished by the equal subanastomosing lamellae. It belongs to the section *Fragiles*.

Pholiota ventricosa sp. nov.

Gregarious or cespitose, on the ground at the base of living pine trees; pileus 7–8 cm., convex, obtuse, reddish-brown, disc often lighter, surface subdry, minutely yellow fibrillose to subglabrate, margin even, subappendiculate with the fibrous remnant of the ruptured veil; lamellae subsinuate, crowded, rather broad and subventricose, edge thin but entire, pale brown becoming dark cinnamon, spores bright ferruginous, ovate or subelliptic, 8–9 × 4–5 μ; veil yellowish-white or pale brownish, very thick, of felted fibers; annulus persistent, thick, margin jagged and remaining erect, almost apical, only 3–5 mm. from top of stalk; stipe stout, conspicuously ventricose, 14–18 × 2–3 cm., largest below the middle, radicating and white mycelioid below, surface yellow-fibrillose to subglabrate, apex above the annulus densely white tomentose, pale brownish, solid, the outer layers tough and fibrous; flesh pale yellow, unchanging, taste bitter, odor none.

Stanford University, Calif., Dec. 12, 1901, C. F. Baker, no. 122.

This conspicuous species seems to be somewhat closely related to *Pholiota caperata* Pers. but it may be distinguished by the ventricose radicating stem which is white tomentose, not scaly, above the nearly apical erect margined annulus, and by the smaller spores.

Flammula Californica sp. nov.

Gregarious or cespitose, under trees, probably from buried rotten wood; pileus 4–7 cm., expanded, subumbonate, pale ochraceous brown, umbo often darker, glabrous, subhygrophanous, margin entire; lamellae subsinuate-decurrent, heterophyllous, crowded, subventricose, pale ochraceous to fusco-ferruginous, spores ferruginous, elliptic, 6–7 × 4 μ; stalk 5–6 cm. × 3–4 mm. subequal, slightly enlarged at apex and base, glabrous above, brown fibrillose below, base white myceloid bringing up attached sand and fragments, pale brown, apex yellowish-white, solid; flesh cream-colored, unchanging, taste and smell mild.

Stanford University, Calif., Dec. 5, 1901, C. F. Baker, no. 167.

The glabrous, subhygrophanous pileus places this species in the section *Udae*.

Hebeloma sericipes sp. nov.

Solitary, among decaying oak leaves; pileus 4–6 cm., broadly convex to plane or subdepressed, obtuse, pale olive brown, dry, disc glabrous, margin silky fibrillose, entire; lamellae sinuate, crowded, subnarrow, nearly plane, white to ochraceous brown, edge white, erose, spores elliptic or subovate, varying in size, smooth, often with a large central vacuole, 7–10 × 5–7 μ; universal veil white, arachnoid; stalk 4–6 cm. × 7–9 mm., equal, subglabrate below, the upper half conspicuously silky-fibrillose, white, solid, crisp; flesh white, unchanging, taste mild, pleasant, odor sickish like chestnut flowers.

Stanford University, Calif., Dec. 3, 1901, C. F. Baker, no. 148. (Section *Indusiatae*.)

Hebeloma Bakeri sp. nov.

Solitary, among decaying oak leaves; pileus 5–7 cm., expanded, cream color, disc darker, viscid and slimy, glabrous,

margin entire; lamellae deeply sinuate, heterophyllous, crowded, subventricose, pale ochraceous brown, edges white and suberose, spores elliptic-ovate, 10–12 × 6–7 μ, usually with a large central vacuole; veil none; stipe long, about 8 cm. × 7 mm., equal, subglabrous below, pruinose above, colored like the pileus, solid; flesh white or cream, unchanging, taste and smell mild.

Stanford University, Calif., Dec. 4, 1901, C. F. Baker, no. 147.

This species belongs to the section *Denudatae*. It is somewhat closely related to *Hebeloma crustuliforme* Bull., that has been credited to California, but it is clearly different in its deeply sinuate gills, longer solid stem and mild taste and odor.

Cortinarius nudipes sp. nov.

Gregarious in grassy places; pileus 5½–6½ cm., convex to expanded, obtuse, clear bright reddish-brown, disc darker, smooth, shining, viscid, margin entire, subinflexed; lamellae strongly heterophyllous, adnexed, rounded behind, crowded, rather broad, narrowed toward the margin, ochraceous cinnamon (probably pallid when young), spores ochraceous-cinnamon, elliptical, smooth, about 7 × 4 μ; cortina fugacious; stipe about 5 cm. × 8–10 mm., even or slightly enlarged above, entirely smooth or with a few loose fibers below, white above, sordid at base, hollow; flesh outer layers white, pellucid within, unchanging, taste and odor mild, brittle when dry.

Stanford University, Calif., Dec. 4, 1901, C. F. Baker, no. 124.

This species belongs to the subgenus *Phlegmacium*, section *Cliduchi*. It is perhaps nearest to *C. maculipes* Pk.

Cortinarius radians sp. nov.

Among decaying oak leaves; pileus 7½–11 cm., expanded, obtuse, bright brown with grayish disc and radiating streaks of gray, subsmooth but minutely radiate-fibrillose, scarcely viscid, margin thin, entire, inflexed or at length subrevolute; lamellae heterophyllous, narrowly sinuate, crowded, narrow but subventricose, (pallid?) to dark cinnamon, spores ferruginous-cinnamon, narrowly ovoid, granular, 9–11 × 5–6 μ; cortina thin, fragile, fugacious; stipe 6½–8½ × 1½–3 cm.,

subequal but slightly enlarged below, nearly smooth or with a few loose fibers below, brown, solid but softer within; flesh pale brown, unchanging, taste and odor mild, subfirm when dry.

Stanford University, Calif., Dec. 4, 1901, C. F. Baker, no. 129.

This belongs to the subgenus *Phlegmacium*, section Cliduchi. It is a larger plant than *C. nudipes* and can be distinguished by the solid brown stipe and the radiate gray center of the pileus.

Hypholoma Californicum sp. nov.

Densely cespitose on or near the base of oak stumps; pileus thin, 5–5½ cm. convex, then expanded and subumbonate, deep rich brown, smooth, hygrophanous, margin entire (or obscurely striate in dried specimens); lamellae adnexed or subfree, subcrowded, slightly ventricose, pale brown at first then darker, spores dark purplish brown, oblong-elliptic, 5–6 × 3 μ; veil white, of thin fibers soon breaking away from the stem but more closely woven toward the margin, appendiculate; stalk 7–10 cm. × 4–5 mm., equal, glabrous but uneven with small irregular swellings, sordid white marked with brownish stains on drying, hollow, cartilaginous, fragile, often splitting; flesh thin, pale brownish, unchanging, taste and smell mild (normal agaric).

Summit of Coast Range, near Palo Alto, Calif., Dec., 1901, C. F. Baker, no. 86.

This species somewhat closely resembles *Hypholoma longipes* Peck from southern California, but differs in its larger size, ventricose gills, and smaller, more oblong spores.

Psathyrella fragilis sp. nov.

Gregarious, in decaying beds of pine needles; pileus very thin and fragile, 4–8 mm., subconic to broadly convex, light brownish-gray when young, becoming pale gray with the disc usually darker, minutely furfuraceous, deeply radiate sulcate from disk to margin; lamellae subfree, heterophyllous, subdistant, ventricose, pale gray, not perceptibly blackened with age, spores hyaline, faintly blackened in mass, oblong-elliptic, often with one small vacuole, 8–9 × 4–5 μ; stipe filiform, 2–3 cm. × ¾–1 mm., equal or slightly enlarged

above, smooth above, minutely furfuraceous below, waxy white above, gray or pallid below, hollow, cartilaginous; flesh white, unchanging, taste and smell mild.

Stanford University, Calif., Nov., 1901, C. F. Baker, no. 90.

This exceedingly delicate, fragile species is somewhat closely related to *Psathyrella disseminata* Pers., from which it may be distinguished by its still smaller size, paler color, and by the very light colored hyaline spores that do not blacken the gills. The spores too are symmetrical, not inequilateral as in that species.

Hypodermataceae.

Hypodermopsis gen. nov.

Ascoma elongate, black, minute, confluent with the host tissues (as in *Hypoderma*); ascospores elliptic or spindle-shaped, brown, two or more septate.

This is not to be confounded with *Rhytidhysterium*, although the spore characters are the same. In the latter genus the ascoma is fully erumpent with inrolled lips that expand to discoid when moistened. It should probably be placed in the Cenangiaceae rather than in the Hypodermataceae. This family when properly defined forms a natural group in which the elongated ascoma is buried, having its walls more or less completely blended with the host tissue. The structure is comparable to that of *Rhytisma* in the Phacidiaceae or of *Phyllachora* in the Dothideales.

Hypodermopsis sequoiae sp. nov.

Ascomata scattered, broadly elliptic or subangular, prominently convex, the margin confluent with the epidermis, smoothish or somewhat wrinkled, the lips closely connivent, forming a subprominent medial line, about $\frac{3}{4}$–1 × $\frac{1}{2}$–$\frac{3}{4}$ mm.; asci subcylindrical, 70–75 × 8–10 μ; paraphyses abundant, thread-like, forming a poorly defined epithecium; ascospores distichous, subspindle-shape, olivaceous, 3-septate, not constricted, about 18 × 6 μ.

On dead twigs and needles of *Sequoia sempervirens*, Sum-

mit of Coast Range, near Stanford University, Calif., Nov. 15, 1901, C. F. Baker, no. 81.

Hysteriaceae.

Gloniella pentstemonis sp. nov.

Erumpent-superficial, the base buried in the cortex, scattered or gregarious, not blackening the surface, straight or slightly curved, ends acute, dull black, lips connivent, but not closely appressed, smoothly rounded, not striate, 1–1½ × ½ mm.; asci clavate, 60–70 × 8–10 μ; paraphyses numerous, at first septate with free ends, finally forming a brownish epithecium; ascospores obliquely monostichous, hyaline, subovate, at length 3-septate and slightly constricted at all of the septa, 15–18 × 6–7 μ.

On dead stems of some cultivated *Pentstemon*, Stanford University, Calif., Nov. 22, 1901, C. F. Baker, no. 76.

Lindau in Engler & Prantl, Pflanzenfamilien follows Rehm in placing part of the Saccardian species of *Gloniella* in the Hypodermataceae under the name *Gloniella* and part in the Hysteriaceae under the new generic name *Hysteroglonium*. This disposition of the species is probably well founded but the original description of *Gloniella* clearly shows that it was intended as a genus of the Hysteriaceae and not of the Hypodermataceae. The name should therefore be retained for those hysteriaceous species that were first included in it. It is in this sense that the name is used above since our species clearly belongs in the Hysteriaceae.

Dothideaceae.

Dothidea yuccae (El. & Ev.).

Phyllachora yuccae Ell. & Ev., Bull. Torrey Club, **22**: 440. 1895.

Stromata thickly scattered, at first buried and long covered by the epidermis, at length fully erumpent, black, elliptical, flattened, about ¾ × ½ mm., roughened by the numerous, minute ostioles; ascigerous cavities small, 60–80 μ; asci subcylindric or narrowly ovate, 70 × 12–14 μ; ascospores subdistichous, ovate, nearly equally uniseptate, the lower cell

slighly narrower, constricted, light fuscous, subpellucid, 16–20 × 7 μ.

On dead leaves of *Yucca* sp., Stanford University, Calif., Nov. 12, 1901, C. F. Baker, no. 71.

The somewhat immature stages agree perfectly with the type of *Phyllachora yuccae* from Mexico.

AMPHISPHAERIACEAE.

Trematosphaeria cactorum sp. nov.

Perithecia scattered or gregarious, conic-spheroid, rough, dull black, not collapsing, 130–180 μ, ostiolum indistinct; asci subcylindric, short pedicellate, thin-walled, 100–120 × 8–10 μ; paraphyses abundant, thread-like; ascospores longitudinally monostichous, ovate-oblong, fuscous, 3-septate, one medial cell usually enlarged, ends obtusely conic, 20–25 × 7–8 μ.

On old spines of *Cereus* sp., Stanford University, Calif., Oct. 19, 1901, C. F. Baker, no. 1.

PLEOSPORACEAE.

Metasphaeria washingtoniae sp. nov.

Perithecia densely gregarious over large areas, often two or three linearly confluent, at length blackening the substratum, elevating and finally rupturing the epidermis, black, white within, subspheroid, not collapsing, ostiolum obscure, about 150 μ; asci subcylindric, about 70 × 12 μ; paraphyses numerous, rather broad (2 μ), branching above, with the tips irregular and subswollen; ascospores distichous, hyaline, strongly constricted into two unequal parts, 3-septate, or at length 4-septate, about 20 × 4 μ.

On dead petioles of *Washingtonia*, Stanford University, Calif., Nov. 26, 1901, C. F. Baker, no. 25.

XYLARIACEAE.

Xylaria Californica sp. nov.

Gregarious or subcespitose; stromata slender, simple, not branched, erect or variously flexed, reaching 7 cm. or more long, the basal portion densely hirsute with stiff, spreading, dark brown hairs, about 1½ mm. thick, fertile portion 2–2½ cm. long by about 2 mm. thick, sterile apex about 1 cm. ×

1 mm., fertile portion whitened by the conidia when young; conidia abundant, narrowly fusiform, hyaline, continuous, 10–11 × 3 μ; perithecia 50 or more, prominent, subhemispheric, black, ostiolum strongly papillate; asci cylindric, 75–85 × 7 μ; ascospores longitudinally monostichous, subinequilateral, dark brown, about 14 × 6 μ.

On decayed, partly buried sticks, summit of Coast Range, San Mateo Co., Calif., Nov., 1901, C. F. Baker, no. 105.

SPHAERIOIDACEAE.

Sphaeropsis stictoides sp. nov.

Amphigenous; pycnidia scattered, without spots, buried, black, rather corky, about ½ mm., the papilliform ostiolum erumpent, surrounded by the whitish upturned leaf tissue; sporophores unusually long, slender, hyaline, about 20 × 2 μ; sporules irregularly oval or oblong, often inequilateral, ends subacute, continuous, brown, 26–28 × 9–11 μ.

On fallen rotting leaves of *Eucalytus* sp., Stanford University, Nov. 26, 1901, C. F. Baker, no. 5.

The whitish upturned leaf tissue bordering the pycnidia gives this species a striking resemblance to a *Stictis*. It is well marked by this and by the very long slender sporophores.

5. New Fungi from Various Localities.

Aecidium helianthellae Arthur, sp. nov.

Spermogonia epiphyllous, few and inconspicuous. Aecidia hypophyllous on discolored spots, crowded in circular groups; peridia low, at first erose, becoming somewhat revolute and coarsely torn; spores globoid, 14–22 μ in diameter, minutely roughened, but usually appearing smooth, wall thin, nearly colorless.

On leaves of some species of *Helianthella*, Alcove, Wyoming, July 1, 1901, Leslie Goodding, no. 178.

Cercospora thermopsidis sp. nov.

Spots yellowish or pallid, not bordered, irregular, angular bounded by the veins, 3–4 mm. or by confluence much larger involving considerable areas; conidiophores amphigenous but mostly hypophyllous, densely fascicled, forming subglobose masses that are at first scattered and olivaceous but be-

come densely gregarious and black, the single hyphae olivaceous, continuous, about 25–35 × 3 μ; conidia abundant subhyaline, subcylindric, straight or slightly flexed, ends rounded, minutely guttulate, continuous, or at length faintly 1–2-septate, 75–90 × 5 μ.

On *Thermopsis arenaria*, Glen Rocks, Montana, July 15, 1901, Aven Nelson, no. 4818.

Ohleriella gen. nov. (Amphisphaeriaceae).

Perithecia as in *Amphisphaeria*, asci large, at first 8-spored, the young spores hyaline and several-celled, at maturity brown and separating within the ascus at all the septa, the ascus thus becoming many-spored and the spores unicellular.

This is clearly related to *Ohleria* in which the 4-celled spore divides into two 2-celled parts at maturity, the ascus thus becoming 16-spored, or it may be compared to a *Trametosphaeria* in which the spores fall to pieces in the ascus before maturity.

Ohleriella Neo-mexicana sp. nov.

Perithecia thickly scattered, black, hemispheric-mammillate, erumpent, the base remaining covered by the whitened wood fibers, not collapsing, ostiolum conspicuous, strongly papillate, ½–¾ mm.; asci large, stipitate, subcylindric, at maturity 48-spored, 150–200 × 25–30 μ; paraphyses abundant, thread-like; ascospores about three-ranked, at first cylindric, hyaline, 5-septate, at maturity dark brown, opake, separating into six suborbicular or from pressure subquadrate bodies that are about 8 μ in diameter.

On old whitened woody stems, Albuquerque, New Mexico, Nov. 29, 1901, T. D. A. Cockerell.

Puccinia Oregonensis sp. nov.

I. Involving considerable areas on the leaves and stems; spermagonia minute, light brown, usually epiphyllous; pseudoperidia densely aggregated, often amphigenous, short and broad, ¼ × ¾ mm., margin short, somewhat lacerate, erect, pseudoperidial cells 20–25 × 30 μ or occasionally much larger, conspicuously roughened with short and prismatic or occasionally longer and flexuous ridges; aecidiospores irregularly

oval, unequal in size, averaging 20×16 μ, subsmooth but faintly reticulate, wall rather thick, about $1\frac{1}{2}$ μ.

II. Uredospores not seen.

III. Teleutosori hypophyllous on indefinite yellowish areas, scattered or sometimes confluent, large, $1 \times \frac{3}{4}$ mm., oval, long covered by the thin epidermis, finally free and conspicuous, dark brown, nearly black; teleutospores dark brown, oval, ends rounded, apex not thickened, slightly constricted, epispore thick, opake, roughened with prominent rounded tubercles, stalk colorless, fragile, often broken away.

On *Sanicula bipinnata*, Corvallis, Oregon, Apr. 14, 1899, Moses Craig.

This is very distinct from *Puccinia saniculae* Grev. It approaches *P. pimpinellae* (Strauss) Link, but differs in the strongly tuberculate teleutospores, the more conspicucus teleutosori and in the smoother aecidiospore and different markings of the pseudoperidial cells.

Rhopographus Bakeri sp. nov.

Stromata subsuperficial, elliptic, sometimes confluent, black, about 1–$1\frac{1}{2} \times \frac{1}{3}$–$\frac{1}{2}$ mm., acigerous cavities 2 or 3 to several in each stroma, subprominent; asci cylindrical, about 40–50×8 μ; paraphyses thread-like; ascospores distichous, subcylindric, fuscous, 3-septate, strongly constricted, one medial cell often enlarged, about 16×4 μ.

On leaves of some unknown grass, Massinga, near Santa Marta, Colombia, South America, Nov. 17, 1898, C. F. Baker, no. 94.

Podosporium Bakeri sp. nov.

Scattered or sometimes densely cespitose in crowded, obconic masses; stromata dark brown, nearly black, clavate, $\frac{1}{2}$–1 mm. high, 40–60 μ or by confluence 200–500 μ thick, of closely compacted fuscous hyphae with free widely-spreading ends that are 40–60×8 μ and once or twice septate with apex obtusely rounded, occurring on all parts of the stroma but more abundant apically; conidia acrogenous and pleurogenous, stipitate, obovate, 3-septate, apex truncate, dark fuscous, minutely roughened, about 40–60×12–15 μ, tapering below to the slender once or twice septate stalk, which is smooth, light fuscous, 50–100×4 μ.

On dead stems of some woody vine, near Bonda, Colombia, South America, Dec., 1898, C. F. Baker, no. 99.

A Preliminary List of Montana Mosses.

By R. S. Williams.

(Plates 34 to 39.)

The following list includes species collected by the author at various times between the years 1886 and 1897. The region collected over includes but a comparatively small part of the state, being chiefly that of Great Falls, on the Missouri River, the Belt Mountains, fifty or sixty miles eastward, and along the foothills of the Rocky Mountains in the Blackfeet Indian Reservation, all belonging to the Missouri River watershed and about Columbia Falls, situated on the Flathead River, just west of the Rocky Mountains and tributary to the Columbia River. The town of Columbia Falls has an elevation of about 3,200 ft. and is about two miles west of where the Flathead River emerges from the mountains through Badrock Cañon. The mountains near rise about 4,000 ft. above the town and snow of the preceding winter frequently lies on their summit till August. The western slope has two or three times the rainfall of eastern Montana and is well forested.

For assistance in preparing this list the author is chiefly indebted to Mrs. Britton, also to Professor Macoun who has loaned many valuable specimens for comparison. The date given is that of the species when in best fruiting condition.

Sphagnum Warnstorfii viride Russow. Belt Mts., near Neihart, 6,000 feet; Rocky Mts., North Fork Cut-bank Cr. (113).

Sphagnum teres (Schimp.) Aongstr. On wet mountain side at head of Macdonald Lake. The globose antheridia when separated out on a slide are readily seen by the unaided eye (314).

Sphagnum teres squarrosulum (Lesq.) Schlieph. Macdonald Lake (315).

Andreæa petrophila Ehrh. Macdonald Lake, Aug. 3 (316)

Gymnostomum rupestre Schleich. Tenderfoot Cr., Belt Mts., a small form, Aug. (133).

Gymnostomum curvirostrum (Ehrh.) Hedwig. Giant Spring, near Great Falls, Belt Mts., Columbia Falls, March (13).

Weisia viridula Brid. On earth over ledges of rocks near foot of Teakettle Mt., Columbia Falls. Apparently very rare in Montana (382).

Dicranoweisia crispula Lindb. Belt Mts., Columbia Falls, common (108).

Dicranoweisia compacta (Schleich.) Schimp. An alpine species growing in compact tufts with smaller leaves than the preceding, basal leaf-cells shorter and thinner walled and teeth not so deeply inserted under the mouth of the capsule. Forty-mile Cr., Blackfeet Ind. Reserv.; Essex, G. N. Ry., 7,000 ft.; Stanton Lake, Rocky Mts., 7,000–8,000 ft. (422).

Cynodontium Schisti (Wahlen.) Lindb. On damp earth over ledges of rock at 4,000 ft., June 1, Columbia Falls (295)

Cynodontium torquescens (Bruch.) Limpr. On rocks 5,500 ft., Neihart (183).

Cynodontium strumiferum (Ehrh.) DeNot. On rocks at 3,500 ft., Columbia Falls, June 15; Neihart, Belt Mts.

Oncophorus virens (Swartz.) Bridel. Columbia Falls, June 24; Observation Mt., Blackfeet Ind. Reserv. (322).

Oncophorus virens serratus (Br. & Sch.) Limpr. Columbia Falls, June 24, common along streams (198).

Oncophorus Wahlenbergii Brid. On decayed logs, May 22, Columbia Falls, Tenderfoot Cr., Belt Mts. (218).

Dichodontium pellucidum Americanum Lesq. This variety seems to be intermediate between *pellucidum* and the variety following. It is scarcely to be distinguished from *pellucidum* by the basal cells, differing chiefly in its smaller size with leaves less highly papillose. Along river banks on wet sand, May 4, Columbia Falls (327).

Dichodontium pellucidum fagimontanum (Brid.) Schimp. This is a still smaller variety with leaves often ovate and only $\frac{2}{3}$–1 mm. long. It is mostly darker colored than the species. On earth at 7,000 ft., near Columbia Falls (328).

Dichodontium flavescens (Dicks.) Lindb. A common species in the Rocky Mts. of northern Montana, on wet rocks about falls and along streams. Distinguished from any form of *pellucidum* by the leaves comparatively smooth above and teeth of the margin separated by 3 to 5 or more intervening cells. In the preceding, each marginal cell forms more or less of a tooth in the upper part of the leaf (269).

Dichodontium flavescens fluitans n. var. A dark colored plant growing on rock under water with stems up to 10 cm. long. Columbia Falls (326).

Dicranella crispa (Ehrh.) Schimp. Specimens mostly dioicous. Occasionally a ♂ flower is borne on a branch of the fruiting plant. Nyack and Essex, G. N. Ry., Aug. (236).

Dicranella Schreberi (Swartz) Schimp. Borders of marshes, Columbia Falls. Sterile tufts up to 5 or 6 cm. high grow by the side of much shorter fruiting plants, Sept. (207).

Dicranella Grevilleana (Br. & Sch.) Schimp. Specimens dioicous or mostly so. The species may be known by its recurved leaves, the scarcely elongated, parenchymatose cells of the exothecium and capsule furrowed when dry. Essex, G. N. Ry., Aug. 19 (376).

Dicranella subulata (Hedw.) Schimp. Essex, Aug. 24 (375).

Dicranella varia (Hedw.) Schimp. Along rivers and about springs on wet sand. Tenderfoot Cr., Belt Mts., Columbia Falls, Oct. and May (134).

Dicranum Starkei Web. & Mohr. Summit, G. N. Ry., 5,000 ft.; Macdonald Lake, 4,500 ft., Aug. 18 (237, the common form, 324, a taller form).

Dicranum hispidulum n. sp. (Plate 34.)

Monoicous, perigonium close under the perichaetium, of 4 or 5 broad, more or less pointed leaves mostly costate. In compact tufts much like the smaller forms of *D. Starkei*. Stems usually without radicles and few branches, up to 2 ½ cm. high, the cross-section nearly round, .180 mm. in di-

ameter, with distinct central stand and outer cells with but slightly thickened walls. Leaves spreading all round, rough on back and margins above with irregular, mamillate papillae, ovate-lanceolate, 1½-mm. long, cross-sections showing no stereid band or distinct guide cells, the cells on either side of costa near middle of leaf often doubled for five or six rows outward. Costa excurrent, usually .040–.050 mm. wide at base and .050–.080 mm. above. Leaf-cells scarcely elongated and irregular in upper part, median cells .010 mm. wide and .010–.020 mm. long, alar cells forming a distinct group of somewhat enlarged, nearly square or inflated more or less colored cells. Cell walls not pitted or distinctly thickened. Capsule oval, slightly curved before opening and barely strumose, 1½ mm. long without lid. Lid obliquely rostrate, about ¾ mm. high. Exothecal cells rectangular, 2–4 times longer than broad. Well developed annulus of 2 or 3 rows of cells. Teeth split to below the middle. Smooth spores up to .012 mm.

This species is somewhat intermediate between *H. Starkei* and *H. falcatum*. It differs from both in the leaves being only half as long and scarcely falcate or secund. The first also has leaf-cells with thickened and pitted walls and cells twice longer, while the second has a poorly developed annulus, alar cells less distinct, and the exothecal cells shorter and broader, from roundish to one and one-half times longer than wide. Collected at head of Macdonald Lake, Aug. 3, 1895, with capsules not quite nature (323).

Dicranum flagellare Hedw. On decayed logs, apparently rare in Montana. Columbia Falls, Oct. 8 (35).

Dicranum elongatum Schleich. In crevices of slide rock. April and May, Columbia Falls (222).

Dicranum fuscescens Turn. Common at the base of trees and on old logs. Belt Mts., Upper Sun River, Columbia Falls, Aug. 30 (197).

Dicranum congestum Brid. On rocks, Sept., Columbia Falls (442).

Dicranum Muhlenbeckii Bry. Eur. On rocks, July 24, Bad-rock Cañon near Columbia Falls (196).

Dicranum scoparium (L.) Hedw. Common Belt Mts., Columbia Falls, Oct. and May (28).

Dicranum Howellii Ren. & Card. This seems to intergrade with the preceding and be rather a variety of it. Columbia Falls, Oct. (365).

Dicranum Bonjeani De Not. Apparently rare in Montana. South Fork Cut-bank Cr. (416).

Dicranum Bergeri Bland. In swampy places. Macdonald Lake, Columbia Falls, Aug. (195).

Dicranum undulatum Ehrh. Highwood and Belt Mts., sterile; Columbia Falls, common, April (162).

Fissidens bryoides (L.) Hedw. Tenderfoot Cr., Belt Mts., July; Columbia Falls, Aug. (209).

Fissidens adiantoides (L.) Hedw. On old stumps and logs in swamp. Nov. 26, Columbia Falls (238).

Fissidens grandifrons Brid. Giant Spring, Great Falls; North Fork Sun River, Columbia Falls (5).

Octodiceras Julianum (Savi.) Brid. Apparently rare in Montana. Giant Spring, Great Falls (115).

Ceratodon purpureus (L.) Brid. Common. Grows in rather tall, hemispherical tufts, sterile, on rock, with rather different aspect from the common form on earth (36).

Distichium capillaceum (Swartz.) Br. & Sch. Common (38).

Distichium inclinatum (Ehrh.) Br. & Sch. Often growing with the preceding but much rarer. Sun River Cañon, Columbia Falls (37).

Seligeria campylopoda Kindb. (Plate 35.) Tenderfoot Cr., Belt Mts., July, and near Columbia Falls, Oct., on rock partly calcareous. The specimens from the Belt Mts. were never observed to branch but those from Bad-rock Cañon occasionally send out a branch from near the base of the stem. This branch from a fertile plant may bear an antheridial bud, thus the specimen becomes autoicous although usually dioicous; I have even found a synoicous flower with the long archegonial and the short antheridial bracts mixed in together (131).

Blindia acuta Br. & Sch. On wet, shaded rock, Nyack, G. N. Ry., Aug. (239).

Pterygoneurum cavifolium (Ehrh.) Jur. River bank, on bare sandy soil, April 12; Columbia Falls (240).

Pottia Heimii (Hedw.) Br. & Sch. Lower Sand Coulee, Missouri River, near Great Falls, June 17 (46).

Pottia Heimoides Kindb. The capsule is much more elongated than in the preceding, with a row of pale, slightly transversely elongated, smaller cells about the mouth, scarcely forming an annulus however. The seta apparently becomes dark red with age. Vein toward apex of leaf either vanishing or excurrent. July 9, shore of St. Mary's Lake and Cut-bank Cr., Blackfeet Ind. Reservation, Lower Sand Coulee, Columbia Falls (47).

Didymodon rubellus (Hoffm.) Br. & Sch. Belt Mts., Great Falls, July; Columbia Falls, Oct. (55).

Didymodon tophaceus (Brid.) Jur. Great Falls, in wet crevices of rock, Nov. and March (12).

Didymodon cylindricus (Bruch.) Br. & Sch. Only found on a single log in the Flathead River bottom at Columbia Falls. Specimens small and sterile (329).

Ditrichum giganteum R. S. Williams, Bull. N. Y. Bot. Garden, Vol. 2, No. 6: 113, 1901. Plate 15. Belt Mts., Columbia Falls, fruiting on wet sand, July 30 (110).

Ditrichum flexicaule (Schleich.) Hampe. Bad-rock Cañon, Flathead River, July 8; Belt Mts. (294).

Ditrichum ambiguum Best. Bad-rock Cañon, on earth 3,300 ft., June 24; Essex, G. N. Ry., 4,300 ft., August 5 (241).

Desmatodon latifolius (Hedw.) Br. & Sch. Neihart, Belt Mts., 6,000 ft., Essex, G. N. Ry., 4,400 ft.; Two-medicine Lake and Big Badger Cr., Blackfeet Ind. Reservation, July (179).

Desmatodon latifolius muticus Brid. Forty-mile Cr. and Two-medicine Lake, Blackfeet Ind. Reservation, August 15 (423).

Desmatodon cernuus (Hueben.) Br. & Sch. Near mouth of Sand Coulee, Aug. 27; Tenderfoot Cr., Belt Mts (51).

Desmatodon arenaceus Sulliv. & Lesq. Tenderfoot Cr.; Sand Coulee, Aug. 13 (56). This species is sometimes con-

fused with *D. obtusifolius* which has larger leaf-cells mostly quite distinct to apex, a costa less stout and perhaps always disappearing below apex and leaf margin less revolute with point of leaf more acute. The annulus of *arenaceus* is composed of a single row of large somewhat triangular cells and the lid has a rostrate beak about one-third to one-half the capsule in length.

Aloina brevirostris (Hook. & Grev.) Kindb. On clayey soil in spray of Lower Falls of Missouri River. Columbia Falls on bare clayey soil, Sept. & Oct. (224).

Barbula unguiculata (Hud.) Hedw. Steep clayey bank of Missouri River below Great Falls, May (189).

Barbula fallax Hedw. On sand in old river channel, Nov. and April, Columbia Falls (331). Kindberg's *B. sparsidens* evidently belongs here.

Barbula subfallax Muell. Stanton Lake, G. N. Ry.; Columbia Falls, Aug., on sand along river bank near high-water mark (242).

Barbula reflexa (Brid.) Brid. (*B. recurvifolia* Schp.) Fruiting specimens referred here were collected on a log covered with silt in the Flathead River bottom, Nov. These specimens are small with leaves mostly 1 mm. or less long, except the perichaetial. The stem leaves are distant, strongly decurrent and roughly papillose on both faces. The capsules are rather short, ovate-oblong rather than cylindrical, with a beak to the lid nearly as long. Annulus wanting, the margin of the capsule very irregular. Teeth scarcely twisting half round and from a basilar membrane scarcely extending above the mouth. I have not seen fruiting specimens, either European or American for comparison but Bridel in his original description calls special attention to the leaves being half the size of *fallax*. The tall sterile forms often growing on rock and referred to *recurvifolia* are perhaps more closely related to *fallax*.

Barbula vinealis Brid. Tenderfoot Cr., Belt Mts., 5,000 ft., on rocks. The sterile specimens placed here have a costa not excurrent, upper leaf-cells obscure, .004 to .006 mm. in

diameter, basal cells .008 or .009 mm. wide and from nearly square to twice longer than wide (163).

Barbula cylindrica (Tayl.) Schimp. Columbia Falls, 3,100 ft., on rock. These specimens have an excurrent costa, upper leaf-cells distinct, .008 mm. in diameter and lower cells up to .012 mm. wide. The stem leaves decrease in size downward much more than in the preceding (325).

Barbula gracilis (Schleich.) Schwaegr. Tenderfoot Cr., Belt Mts., on rock. Sterile specimens probably this (143).

Barbula perannulata n. sp. (Plate 36.)

Dioicous. Plants small, ⅓–1 cm. high. Upper leaves mostly linear with broad, obtuse or slightly acute point. Outer perichaetial leaves very similar with slightly enlarged base, the middle with a more or less distinct limb and the 2 or 3 inner, convolute with a distinct, narrowed point usually ¼ or more the length of the clasping part, the outer perichaetial leaves extending to or above the tips of the inner. Upper leaves up to 2 mm. long, deeply channeled and crenulate-papillose on margin above, lower leaves 1 mm. or less, all with flat borders and costa vanishing below the apex. Leaf-cells distinct, roundish above, .006–.008 mm. in diameter with 1 or 2 papillae to each cell. Lower cells hyaline, somewhat irregular, 2–4 times longer than wide. Capsule ovate-oblong, with lid up to 2 ½ mm. long, the lid often nearly as long as capsule. Annulus large, of 3 rows of cells. The twisted, papillose teeth from a solid basal membrane about ⅙ the height of the teeth. Mouth of capsule with 5 or 6 rows of small roundish cells with groups of 4 or 5 twice larger cells interspersed here and there. Smooth spores up to about .008 mm.

This species is near *convoluta* but may be distinguished at once by the perichaetium. In *convoluta* the sheathing leaves project one-half or more above the tips of the next surrounding leaves and are mostly truncate-crenulate or with a very short point. On earth, June 18, 1894, Columbia Falls (292). Also collected by J. B. Leiberg, Traille River Basin, Idaho (190).

Barbula tortuosa (L.) Web. & Mohr. Belt Mts., June; Columbia Falls, Oct. (25).

Barbula fragilis (Drumm.) Bry. Eur. Tendertoot Cr., Belt Mts.; Birch Cr., Blackfeet Ind. Reserv. (216).

Tortula subulata (L.) Hedw. Belt Mts., Great Falls; Columbia Falls, June; Two-medicine Lake (24).

Tortula ruralis (L.) Ehrh. Common. Belt Mts., Great Falls; Columbia Falls (18). Small forms of this appear much like *intermedia*. The borders are scarcely revolute, the hair point shorter and smoother than in ordinary *ruralis*, but the leaves are recurved and narrowed toward the apex as in the latter. *B. intermedia* has the leaf just about as wide near apex as at base with the apex truncate or emarginate. Size of leaf-cells does not seem to afford any good character for separating the two species.

Scouleria aquatica Hook. Neihart, Belt Mts.; Macdonald Lake, Aug. 6 (180).

Grimmia conferta Funck. Lower Sand Coulee (53).

Grimmia conferta obtusifolia Bry. Eur. Columbia Falls, Summit, G. N. Ry., 5,000 ft. (32).

Grimmia ambigua (Sulliv.) Lesq. & James. These specimens have a rough, hyaline point like *apocarpa* but the upper leaf is not bistratose as in that species, only one or two rows of marginal cells being doubled above. The teeth are solid or nearly so. May 16, Columbia Falls (273).

Grimmia apocarpa (L.) Hedw. Neihart, Belt Mts., Sept. (99).

Grimmia apocarpa gracilis Web. & Mohr. Belt Mts., July; Columbia Fulls, Sept. (138).

Grimmia rivularis Brid. Abundant. Belt Mountains; Summit, G. N. Ry., 5,000 ft.; Columbia Falls, on old logs near high-water mark on Flathead River, Aug. and Sept. (98).

Grimmia anodon Bry. Eur. Neihart and Tenderfoot Cr., Belt Mts.; Columbia Falls, Sept. (132).

Grimmia plagiopoda Hedw. Lower Falls of Missouri River, May (11).

Grimmia pulvinata (L.) Smith. Lower Sand Coulee, May 26 (245).

Grimmia elatior Bruch. Falls of Tenderfoot Cr., Belt Mts., Oct. 24; Bad-rock Cañon, Columbia Falls. Stems 2½ to 5 cm. high. Capsule exserted on a pedicel about 3 mm. long, more or less horizontal, ribbed, somewhat truncate at base. Hair point rough. Leaves more or less papillose, bistratose above with borders of 4 or 5 thicknesses of cells.

Grimmia torquata Hornsch. Neihart, Belt Mts., 5,000 ft.; Columbia Falls, 3,500 ft. (188).

Grimmia ovalis (Hedw.) Lindb. Belt Mts., Columbia Falls, common, July–Sept. (264).

Grimmia calyptrata Hook. Lower Sand Coulee, Columbia Falls, April (33).

Grimmia commutata Hueben. Columbia Falls (308).

Grimmia montana Bry. Eur. Columbia Falls, June (244).

Grimmia tenerrima Ren. & Card. Head of Macdonald Lake, 5,000 ft.; Flat-top Craig, 6,000–7,000 ft. and Two-medicine Lake, Blackfeet Ind. Reserv., July. Leaf-cells above sometimes mamillose on both faces. The leaves are rather shorter and broader than in *alpestris* with the vein distinct at base (.055 mm. wide) and of about the same width up to the middle. The leaves diminish in size below as in *alpestris* (332).

Grimmia Brittoniae R. S. Williams, Bull. Torr. Club, **27**: 316, June 25, 1900. Bad-rock Cañon, Flat-head River, 3,300 ft. (223).

Grimmia tenuicaulis R. S. Williams, l. c. Neihart, 5,000 ft. (139).

Grimmia patens (Dicks.) Br. & Sch. Macdonald Lake; Columbia Falls, May 7 (192).

Grimmia acicularis (L.) C. M. Macdonald Lake; Aug. 3 (311).

Grimmia microcarpa (Hedw.) C. M. Essex. G. N. Ry., 7,000 ft.; Macdonald Lake and Avalanche Basin, Aug. (312).

Grimmia heterosticha (Hedw.) C. M. Columbia Falls, May; Macdonald Lake (184). A more slender form is perhaps var. *alopecura* (424).

Grimmia fascicularis (Schrad.) C. M. Head of Macdonald Lake, Aug. (313).

Grimmia ramulosa Lindb. Head of Macdonald Lake, Aug. 3 (367).

Grimmia canescens (Timm) C. M. Neihart (111).

Grimmia canescens ericoides (Web.) C. M. Columbia Falls (368).

Grimmia canescens stricta (Schleich.). Flat-top Craig, 7,000 ft., Blackfeet Ind. Reserv. A variety growing in compact tufts with closely imbricated, broader leaves (425).

Hedwigia albicans (Web.) Lindb. Belt Mts., Columbia Falls, July 18 (187).

Ptychomitrium Gardneri Lesq. On slide rock, Oct. 10, near Columbia Falls (309).

Amphidium Lapponicum (Hedw.) Schimp. Belt Mts., Columbia Falls; Macdonald Lake, Aug., Sept. (50).

Orthotrichum anomalum Hedw. Belt Mts., Sand Coulee, June (3).

Orthotrichum cupulatum Hoffm. Belt Mts., June; Sand Coulee; Forty-mile Cr., Blackfeet Ind. Reservation, Aug. (45).

Orthotrichum urnigerum Myrin. Columbia Falls, May (247). These specimens do not show a preperistome and all the plates of the teeth are striate in various directions, not partly papillose near the middle of the teeth, otherwise they seem to agree quite well with European specimens. The capsule is 16-striate, peristome double, stomata immersed. The variations in the teeth may be owing to the unfavorable conditions in which the specimens undoubtedly matured the fruit.

Orthotrichum alpestre Hornsch. Sand Coulee, May 30, on rock. Little Badger Cr., on rock, and South Two-medicine River, on wood (96).

Orthotrichum pumilum Swartz. Missouri River near Great Falls, on bark of Box-elder, April 1 (52).

Orthotrichum speciosum Nees. Tenderfoot Cr., Belt Mts., Sept., on dead timber, specimens pale and slender. Colum-

bia Falls, on green willows, rather darker colored and more robust, Oct. (265).

Orthotrichum affine Schrad. On bark of the Douglas fir, Columbia Falls. These specimens are very closely related to the preceding and perhaps should be referred to it as a short-stemmed variety of dryer places. Limpricht does not give any very satisfactory differences by which the European plants may be separated. *O. speciosum* is said to be a larger plant with a little seta, capsule less ribbed, upper leaf-cells .018–.020 mm. instead of .012–.014 mm. in diameter and with larger spores (306).

Orthotrichum rupestre Schleich. North Fork of Sun River; Columbia Falls, July 18 (121).

Orthotrichum rupestre var. A more slender form with nearly smooth calyptra, June 15, Columbia Falls (384).

Orthotrichum Macounii Aust. Highwood Mts., June 21, on rock. Specimens referred here are near *O. laevigatum* Zett., which possibly is not found in America. The Montana specimens have a cylindrical, exserted capsule, in size and shape much like *speciosum* and more or less 8-ribbed, with teeth mostly united in pairs and stout cilia between, but the teeth are never strongly reflexed against the rim of the capsule as in the latter (426).

Orthotrichum Schlotthaueri Vent. Columbia Falls, on rock, July 18. Very similar to the preceding and perhaps scarcely a distinct species. It seems to differ only in having teeth less united and smaller, less developed cilia (272).

Orthotrichum obtusifolium Schrad. Columbia Falls, on Cottonwood, June 10 (225).

Merceya latifolia Kindb. (Plate 37.) River bank below Great Falls, on rock constantly wet by spring. Compared with specimens received from Professor Macoun and they are undoubtedly the same. The leaves have both surfaces of each cell covered with up to 6 or 8 small papillae, except those constituting the peculiar broad often reddish-brown border. These cells are smooth, with thickened walls and more or less elongated at right angles to the leaf surface,

giving the cross section a characteristic appearance. The stems, without central strand and with 2 or 3 rows of thick-walled cells at surface, measure about .375 mm. in diameter. The leaves are up to 5 by 3 mm. or more. Kindberg reports it from California and Vancouver Island.

Leersia extinctoria obtusifolia (Funck) Braithw. Columbia Falls, July (359).

Leersia extinctoria pilifera (Funck) Braithw. Columbia Falls, June (310).

Leersia rhabdocarpa (Schwaegr.) Lindb. Belt River Cañon, June; Columbia Falls, July (41).

Leersia laciniata Hedw. Highwood Mts., June. Columbia Falls, July (100).

Leersia Macounii (Aust.) E. G. Britton. Bad-rock Cañon, Flathead River, July (307).

Leersia Selwyni (Aust.) E. G. Britton. Belt Mts., Columbia Falls, July (42).

Georgia pellucida (L.) Rabenh. Neihart, Belt Mts.; Columbia Falls, Aug.–Oct. (40).

Tayloria tenuis (Dicks.) Schimp. Essex, G. N. Ry., 4,000 ft., Aug. 21, on damp logs; Two-medicine Lake, on shady bank (388).

Tayloria splachnoides (Schleich.) Hook. Upper Sand Coulee, Belt Mts.; Highwood Mts., 5,000 ft., June 19 (109).

Physcomitrium Hookeri Hampe. Horseshoe Falls of Missouri River, June 17 (31).

Physcomitrium Coloradense E. G. Britton. Great Falls, on mud of river bank, May (48).

Funaria Americana (Schwaegr.) Lindb. Lower Falls of Missouri River; Tenderfoot Cr., Belt Mts., July 30 (49). This species differs from *calcarea* in its longer-pointed more entire leaves. I am unable to distinguish it in any way from *Mediterranea*.

Funaria hygrometrica (L.) Sibth. Common, Aug.–Oct. (15).

Bartrania Menziesii Turn. Columbia Falls (221).

Bartrania ithyphylla (Haller.) Brid. Belt Mts., Columbia Falls, June (29).

Bartrania Oederiana (Gunn.) Swartz. Columbia Falls (193).

Bartrania pomiformis (L.) Hedw. Macdonald Lake; Columbia Falls, June 18; Essex, 4,200 ft., Aug. (194).

Philonotis fontana (L.) Brid. Belt Mts. Aug.–Sept.; Great Falls; Columbia Falls (30).

Catoscopium nigritum (Hedw.) Brid. Columbia Falls, along mountain streams; North Fork Cut-bank Cr., July 25 (383).

Amblyodon dealbatus (Dicks.) Beauv. Columbia Falls, Sept. (226).

Meesea trichodes (L.) Spruce. Columbia Falls, June (211).

Leptobryum pyriforme (L.) Schimp. Common, June (66).

Plagiobryum Zierii (Dicks.) Lindb. Forty-mile Cr., mixed with *Bryum arcticum*. Near Head of Macdonald Lake, Aug. 7. The neck of the capsule is often not longer than sporangium. It is a larger species than *demissum* with costa of perichaetial leaves mostly entering point but usually hardly excurrent. *P. demissum* has a stout, red costa distinctly excurrent in the upper leaves (317).

Pohlia longicolla alpina (H & H.) Hueben. Neihart, Belt Mts., on rocks, 5,000 ft., Sept. This variety has a shorter neck to the capsule than the type. The species is credited to the Cascade Mts., collected by Lyall. I have seen no other records and no American specimens except these from Neihart. The plant is a glossy species somewhat like *cruda* but may be distinguished from that by the erect, not spreading or reflexed leaves, which are more lanceolate in outline, with much shorter basal cells, those in the angles being very short rectangular to almost square. From *nutans* it may be known by the less perfect peristone, thinner walls of leaf-cells and by the single row of nearly square, not transversely elongated cells about mouth of capsule with margin of irregular outline (186).

Pohlia cruda (L.) Lindb. Common, Belt Mts.; Great Falls; Columbia Falls, June (63).

Pohlia nutans (Schreb.) Lindb. Common, Belt Mts.; Highwood Mts.; Sun River Cañon; Columbia Falls. A very short form, var. *bicolor*, was collected at about 7,000 ft. near Stanton Lake. It greatly resembles *cucullata* in general appearance.

Pohlia cucullata (Schwaegr.) Bruch. Forty-mile Cr., Blackfeet Ind. Reserv., Aug. 15. This species has leaf-cells very thin-walled and much wider (.015–.018 mm.) than the preceding, the exothecal cells are also thin-walled and up to .050 mm. wide and not much elongated. The segments of the endostome are narrow with short-imperfect cilia between (402).

Pohlia commutata (Schimp.) Lindb. Columbia Falls, on earth, at 7,000 ft. This species has relatively broader and shorter leaves than any other of our dioicous *Pohlias*. The segments of the inner peristome are more or less split along the keel with two cilia nearly as long between or sometimes with none even in the same peristome (341).

Pohlia atropurpurea (Wahlenb.) Lindb. fil. Columbia Falls, on wet gravel about springs, May. I am indebted to Harold Lindberg, fil., for the determination of this species. It is dioicous, exannulate, teeth of peristome dark ferruginous, stomata superficial, leaves not or scarcely decurrent, seta large and fleshy above while growing. The leaves are narrower and less serrate than in *carnea* which has light-colored teeth. Not before credited to America, I believe (297).

Pohlia vexans (Limpr.) Lindb. fil. Tenderfoot Cr., Belt Mts., on rocks, Oct. Also determined by Harold Lindberg. It is certainly near *pulchella*, which according to Lindberg has a well-differentiated annulus. *P. vexans* is supposed to have no annulus, but my specimens show a tendency to produce an annulus (in the well-developed capsules) of 1 or 2 rows of slightly smaller but otherwise scarcely different cells that mostly remain attached to the lid, breaking away in small fragments. This is about like the annulus described for *pulchella* in Lesq. & James' Manual. The Montana plant is dioicous, with decurrent leaves, costa red at base and

broad, ⅓ width of leaf base, with leaf-cells long and narrow above, often 1–6 (145).

Pohlia albicans (Wahlenb.) Lindb. Stanton Lake, G. N. Ry. A rather slender form growing amongst grass, Aug. 3, Columbia Falls (248). A taller sterile form approaching *glaciale* was collected at Teakettle Mt. near Columbia Falls (427).

(I am indebted to M. Philibert for a revision of most of the *Bryums*.)

Bryum arcticum (R. Ruthe) Br. & Sch. Forty-mile Cr., Blackfeet Ind. Reserv., Aug. 15 (392).

Bryum pendulum (Hornsch.) Schimp. North Fork of Sun River, 5,000 ft., Aug.; Great Falls, 3,200 ft., June (62).

Bryum calophyllum R. Br. Near Divide Mt., Blackfeet Ind. Reserv., on wet gravelly soil at about 6,000 ft. These specimens have somewhat acutely, but very shortly, pointed leaves. They measure about 2 by 1½ mm. The leaf-cells are very lax, thin-walled and up to .065 mm. long.

Bryum uliginosum (Bruch) Br. & Sch. Belt Mts., Sept.; Columbia Falls, Oct. Spores rather large, .028 to .030 mm. (57).

Bryum intermedium (Ludw.) Brid. Forty-mile Cr., Aug. 15. Leaf-cells rather large, median up to .060 mm. long and .016 mm. wide. Leaf border of 1 or 2 rows of narrower, elongated not very well defined cells and revolute nearly all round. Teeth of peristome with about 25 parallel lamellae and outer plates near base 2 to 2½ times wider than high. Spores somewhat roughened, up to about .020 mm. (147).

Bryum binum Schreb. Columbia Falls, July. On logs and earth in damp places (428). What I take to be a form of this species occurs in marshes amongst tall sedges and reeds. The sterile tufts bear long slender branches, up to 4 or 5 cm., the seta is rather longer and the capsule soon becomes very dark colored (251).

Bryum cuspidatum Schimp. Columbia Falls. On old logs, June 22 (404).

Bryum pallescens Schleich. Belt Mts.; Little Pricklypear Cañon; Highwood Mts.; Great Falls; Columbia Falls, July–Oct. (277, 178, 64).

Bryum alpinum Huds. Head of Macdonald Lake, 5,000 ft., Aug. 3. Costa 140 mm. wide at base and often ending 1 cell below the apex in the upper leaves (335).

BRYUM WILLIAMSI Philibert, Rev. Bryol. **28** : 31. 1900. (Plate 38.)

Dioicous. In compact tufts felted with radicles below and up to 3 cm. high. Stems somewhat branching, rather uniformly leaved above. Leaves erect, imbricated both wet and dry, broadly ovate-lanceolate, entire or minutely serrulate at apex, up to 2 mm. long, flat on borders or recurved along the middle, with 2 or 3 rows of narrow, elongated cells forming a distinct margin. Stout red costa, .080 mm. wide at base, percurrent or ending 1 or 2 cells below apex. Leaf-cells rather elongated rhomboidal to rectangular, median, .050–.060 mm. long and .016–.018 mm. wide, all with thickened but not pitted walls. Capsule elongated-pyriform, not contracted below the small mouth, up to 4 mm. long, with distinct-collum equalling sporangium in length. Lid rather low-convex mamillate. Annulus large. Teeth somewhat papillose, with narrow border, the outer plates below 2½–3½ times broader than high, inner lamellae up to 30, parallel and not connected or irregular and joined by very oblique cross-walls. Basilar membrane of endostome extending about ½ up, the segments very narrow and papillose, with narrow slits between articulations; cilia 2 or 3, and short or nearly equalling segments in length and more or less appendiculate. One or two rows of transversely elongated cells about mouth of capsule. Seta up to 4 cm. high. Nearly smooth spores up to .024 mm.

Growing in very damp or wet crevices of rock by springs. July 6, 1888, Missouri River bank below Great Falls. This species is near *Muhlenbeckii* but differs in the very narrow segments of endostome with narrow slits between the articulations, not rounded perforations, the leaf-cells also are more elongated above and less regularly short-rectangular below (19).

Bryum argenteum L. Belt River; Columbia Falls, June 14 (84).

Bryum caespiticium L. Little Prickly-pear Cañon; Essex, G. N. Ry., Aug. 17 (10).

Bryum capillare L. Highwood Mts.; Lower Falls of Missouri R., July (71).

Bryum obconicum Hornsch. Two-medicine Lake, Aug. These specimens have a very slender capsule up to 5 mm. long and spores up to .021 mm. (393).

Bryum capitellatum C. M. & K. Big Badger Cr., Two-medicine Lake, Essex, Columbia Falls, in rather old fruit, Oct. 17, 5,000 ft. A fine species originally described from sterile plants. It is dioicous, growing in very soft tufts densely felted together with radicles. The leaves above are broadly ovate to obovate, the upper and perichaetial, except the small inner, abruptly terminating in a short hair point more or less reflexed and twisted when dry. The middle and lower leaves are concave, without point, often nearly round, the very lowest small and ecostate. The peristome is that of a well developed *Eubryum*, the capsule much like *caespiticium* in size and shape. Spores smooth, up to .013 mm. (338).

Bryum Duvalii Voit. Columbia Falls, on low, damp ground under heavy timber, sterile. Two-medicine Lake and Divide Cr., Blackfeet Ind. Reservation, July 14 (374).

Bryum ventricosum Dicks. Columbia Falls, Macdonald Lake, Aug. (280, 336).

Bryum turbinatum (Hedw.) Schwaegr. Belt Mts., Sept.; Essex, G. N. Ry., Aug. (340, 103, 146). Tall, sterile specimens growing in spring apparently belong here (429).

Mnium Roellii Brotherus. Belt Mts., 5,000 ft.; Columbia Falls, 4,000 to 5,000 ft., July (60).

Mnium cuspidatum (L.) Leyss. Columbia Falls, June (281).

Mnium venustum Mitt. Columbia Falls, June (212).

Mnium medium Br. & Sch. Columbia Falls, May (282).

Mnium Drummondii Bry. Eur. Columbia Falls, June. The dioicous form (302).

Mnium rostratum Schrad. Columbia Falls, July (303).

Mnium affine Bland. Belt Mts., July (118); Columbia Falls, June, a low form apparently *humile* Milde (430).

Mnium insigne Mitt. Columbia Falls, June, growing with *medium* and closely related to it. It is distinguished from the latter by the longer, narrower leaves, more decurrent and more distant on the stems, which are free from radicles above (407).

Mnium serratum Schrad. Belt Mts.; Columbia Falls, May (70).

Mnium orthorrhynchum Brid. Macdonald Lake, Aug. (220). A small slender form of dryer places evidently belongs here (373).

I am unable to find a single good distinction by which *M. lycopodiodes* can be separated from the preceding which has leaf-cells above about .016 mm. in diameter.

Mnium umbratile Mitt. Plants with leaf-cells somewhat larger, .020 to .025 mm. in diameter in upper leaf are referred here. Belt Mts. (283).

Mnium spinulosum Bry. Eur. Belt Mts., July; Columbia Falls, Oct. (106).

Mnium Blyttii Bry. Eur. Columbia Falls, 5,000 ft., July. This plant has a distinct, colored border, mostly 1 row wide, of elongated cells in the leaf margin, while the upper leaves show a double row of short blunt teeth above. The seta measures up to 5 cm. high. Lid of capsule low-convex, not mamillate. Male plants may be known by the very small leaves just under the perichaetium, which gradually enlarge toward the middle of the stem, then decrease again below (304).

Mnium punctatum elatum Schimp. Columbia Falls, April (69).

Mnium subglobosum Bry. Eur. North Fork Sun River; Forty-mile Cr. and Two-medicine Lake, Blackfeet Ind. Reserv.; Columbia Falls, April (389).

Mnium nudum R. S. Williams, Bryologist, **3**: 6. 1900. Two-medicine Lake and South Fork Cut-bank Cr., Blackfeet Ind. Reserv.; Essex, G. N. Ry., 4,500 ft. (370).

Aulacomnium androgynum (L.) Schwaegr. Belt Mts., Columbia Falls, common, July (39).

Aulacomnium palustre (L.) Schwaegr. Belt Mts., Highwood Mts., Columbia Falls, common, July (67).

Timmia megapolitana Hedw. Belt Mts., Great Falls, Columbia Falls, May. Flowers of this species occur with antheridia clustered at one side of the archegonia wholly without intervening leaves and with pedicels of the antheridia varying from $\frac{1}{5}$ to as long as the antheridia.

Timmia cucullata Michx. Columbia Falls, June (372). (A note on this species has been published in Revue Bryologique, **28**: 1. 1901.)

Timmia Austriaca Hedw. Belt Mts., Columbia Falls, June (59).

Catharinea Selwyni (Aust.) E. G. Britton. June, Highwood Mts., Belt Mts., Essex., G. N. Ry. (116).

Oligotrichum Lyallii Lindb. Two-medicine Lake, Blackfeet Ind. Reserv.; Essex, Great Northern Ry.; Columbia Falls, 7,000 ft. (213).

Pogonatum urnigerum (L.) P. Beauv. Stanton Lake, G. N. Ry. (252).

Pogonatum alpinum Roehl. Belt Mts., Columbia Falls, June (117).

Polytrichum gracile Dicks. Head of Macdonald Lake. These specimens are slender and elongated with rather long capsules (319).

Polytrichum piliferum Schreb. Belt Mts., Columbia Falls, June (101).

Polytrichum juniperinum Willd. Belt Mts., Columbia Falls, Aug. (21). A low form on mountain ridges, 7,000 ft., is var. *alpinum* (431).

Polytrichum strictum Banks. Belt Mts., Columbia Falls, June (102).

Polytrichum commune L. Neihart, Belt Mts., 6,000 ft., Sept.; Macdonald Lake (215).

Buxbaumia indusiata Brid. Yellow Mt., Blackfeet Ind. Reserv.; Columbia Falls, June 14 (190).

Buxbaumia Piperi Best. (Plate 39.) Columbia Falls, Aug. and Sept. (403).

Fontinalis antipyretica L. Belt River (22).

Fontinalis antipyretica gigantea Sulliv. NearMacdonald Lake (391).

Fontinalis Kindbergii R. & C. Head of Macdonald Lake (361).

Fontinalis Neo-Mexicana Sulliv. & Lesq. Columbia Falls (362).

Fontinalis hypnoides R. Hart. Columbia Falls, in small streams. Near Two-medicine Lake, fruiting in shallow pond, Aug. 12 (284). Missouri River, near Great Falls (82).

Dichelyma uncinatum Mitt. Two-medicine Lake, head of Macdonald Lake on logs and bases of trees subject to inundation, Aug. 3 (320).

Alsia abietina Sulliv. Bad-rock Cañon, near Columbia Falls, rare (210).

Neckera Menziesii Hook. Belt Mts., Columbia Falls, fruit rare, Oct. 30 (112).

Pterigynandrum filiforme Hedw. Belt Mts., Columbia Falls, Aug. (91).

Antitrichia curtipendula gigantea Sulliv. & Lesq. Columbia Falls, on trees and rocks (253).

Antitrichia Californica Sulliv. Belt Mts., Columbia Falls, April (144, 267). *A. tenella* Kindb. is a dwarfed form growing on dryer, more exposed places than the preceding (298).

Myurella julacea (Vill.) Br. & Sch. Forty-mile Cr., Blackfeet Ind. Reservation; Macdonald Lake (300).

Leskea polycarpa Ehrh. Sand Coulee, near Great Falls, (26).

Leskea polycarpa paludosa (Hedw.) Schimp. Columbia Falls, at base of trees and on logs (432).

Leskea nervosa (Schwaegr.) Myrin. Columbia Falls, at base of trees and logs on low ground (270).

Leskea tectorum (A. Braun) Lindb. Big Badger Cr., Blackfeet Ind. Reserv., Columbia Falls (360).

Pylaisia polyantha (Schreb.) Br. & Sch. Belt Mts., Great Falls (27); Columbia Falls, Oct. (125).

Climacium dendroides (L.) Web. & Mohr. Belt Mts., Columbia Falls, Oct.–Nov. (127).

Holmgrenia chrysea (Schwaegr.) Lindb. Essex, G. N. Ry., 5,000 to 6,000 ft., on damp rock (379). A variety with shorter more imbricated leaves, 2 mm. instead of 3 mm. long, was collected immersed in spring between the North and South Forks of Cut-bank Cr. It is perhaps the variety *cochlearifolia* Lindb.

Pseudoleskea atrovirens (Dicks.) Br. & Sch. North Fork Cut-bank Cr., Columbia Falls, July (342).

Pseudoleskea oligoclada Kindb. Columbia Falls, on rock, May (256).

Pseudoleskea pallida Best. Tenderfoot Cr., Belt Mts. (151).

Pseudoleskea denudata Holzingeri Best. Columbia Falls, on earth, 7,000 ft., Oct. (343).

Pseudoleskea radicosa (Mitt.) Lesq. & James. Columbia Falls, June 12 (364).

Pseudoleskea rigescens (Wils.) Lindb. Essex and Stanton Lake, G. N. Ry.; Columbia Falls, Aug. (255).

Heterocladium procurrens (Mitt.) Rau & Hervey. Macdonald Lake, Columbia Falls, April (205).

Heterocladium squarrosulum (Voit.) Lindb. Two-medicine Lake and Railway Cr., Blackfeet Ind. Reserv.; Columbia Falls, May (254).

Claopodium Bolanderi Best. Macdonald Lake, Columbia Falls, April (203).

Thuidium abietinum (L.) Bry. Eur. Belt Mts., Sept.; Lower Falls of Missouri River, May; Columbia Falls (76).

Thuidium Blandovii (Web. & Mohr.) Bry. Eur. Neihart, Belt Mts.; Columbia Falls, July (173).

Thuidium recognitum (Hedw.) Lindb. Belt Mts., Columbia Falls, July (156).

Camptothecium aeneum Mitt. Belt Mts., Columbia Falls, March (75).

Camptothecium nitens (Schreb.) Schimp. Columbia Falls (205).

Brachythecium salebrosum Hoffm. Belt Mts. (78); Columbia Falls, Oct. and April (345). Apparently a younger state of this species, growing on earth over stump is (344).

Brachythecium acutum Mitt. Columbia Falls, May (385).

Brachythecium albicans (Neck.) Bry. Eur. Columbia Falls, April (347).

Brachythecium turgidum (Hartm.) C. Hartman. Near Birch Cr., Blackfeet Ind. Reservation. Leaf-cells somewhat thickened and pitted below. Both stem and branch leaves are minutely serrulate in the slender point (scarcely visible under a magnification of 30 diameters) and the perichaetial leaves have a few coarse teeth at base of subula. Sept. 21, fruiting! (401).

Brachythecium rutabulum (L.) Bry. Eur. Columbia Falls, in swamps or very wet places, April (258).

Brachythecium platycladon C. M. & K. Belt Mts., Two-medicine Lake, Columbia Falls, April. I believe this is distinct from any form of *rutabulum*. It grows in very soft, loose mats on damp, shady ground, not in water. The leaves on the average are broader, shorter, more spreading and often complanate, the capsule shorter, larger toward the base and lid lower, also distinctly dioicous plants seem to be the rule (170).

Brachythecium asperrimum Mitt. Belt Mts., Columbia Falls, April (232).

Brachythecium rivulare Br. & Sch. Columbia Falls, May (155).

Brachythecium reflexum (Starke) Br. & Sch. Belt Mts., Sept.; Columbia Falls, Nov. (174).

Brachythecium Starkei (Brid.) Br. & Sch. Columbia Falls, May (346).

Brachythecium velutinum intricatum (Hedw.) Br. & Sch. Columbia Falls, April. Western plants undoubtedly average somewhat larger than eastern or ordinary European specimens. I have found the stem leaves of Montana plants up

to 2.25 mm. long. Limpricht gives 1.8 mm. for the species but there are two European varieties with larger leaves (up to 2.10 mm.) and the more common Montana form exactly matches in appearance the variety as given above (257).

Brachythecium collinum (Schleich.) Br. & Sch. Belt Mts., Essex, G. N. Ry.; Boulder Cr., Little Badger Cr., Two-medicine Lake and Hart Butte, Blackfeet Ind. Reservation. What is considered the typical form of this plant usually grows in rather dry, exposed mountain regions at 5,000 or 6,000 ft. (301). Specimens collected at Great Falls (7) approach the following variety.

Brachythecium collinum subjulaceum Pfeffer. Divide Mt. and Two-medicine Lake, Blackfeet Ind. Reservation. Growing in moister, more shaded places, of larger size with larger, less imbricated leaves (435).

Brachythecium Idahense Ren. & Card. Belt Mts., Columbia Falls. This plant seems to be almost too close to the preceding variety from which it differs, apparently, only in the narrower leaves, which are somewhat variable (88).

Brachythecium erythrorrhizon Br. & Sch. Belt Mts., Nov. 2; Columbia Falls, April (235).

Eurhynchium strigosum (Hoffm.) Br. & Sch. Two-medicine Lake and Forty-mile Cr., Blackfeet Ind. Reserv. (434).

Eurhynchium strigosum robustum Roell. Belt Mts., Sand Coulee, Columbia Falls, Oct. (73).

Eurhynchium strigosum fallax Ren. & Card. Columbia Falls, July (86).

Eurhynchium diversifolium (Schleich.) Mol. & Lorentz. Belt River, Columbia Falls, March (8).

Eurhynchium praelongum Stokesii (Turn.) Dixon. Near Avalanche Basin above Macdonald Lake (348).

Eurhynchium stoloniferum (Hook.) Jaeger & Sauerb. Columbia Falls (299).

Scleropodium obtusifolium (Hook.) R. & C. Giant Spring, Great Falls; Columbia Falls, Macdonald Lake (4).

Porotrichum Leibergii E. G. Britton. Essex, G. N. Ry., 5,000 ft. (380).

Plagiothecium piliferum (Swartz) Br. & Sch. Macdonald Lake, Columbia Falls, June (271).

Plagiothecium pulchellum (Dicks.) Br. & Sch. Belts Mts., Columbia Falls, July (288).

Plagothecium denticulatum (L.) Br. & Sch. Two-medicine Lake, Columbia Falls, July (268).

Plagiothecium Silesiacum (Seliger) Bruch. Columbia Falls, July (260).

Amblystegium Sprucei (Br.) Br. & Sch. Belt Mts., Two-medicine Lake and Little Badger Cr., Blackfeet Ind. Reserv., Columbia Falls, Aug. (154).

Amblystegium serpens (Hedw.) Br. & Sch. Highwood Mts., Columbia Falls, June (129).

Amblystegium varium (Hedw.) Lindb. Columbia Falls, June (14).

Amblystegium compactum (Hook.) Aust. Highwood Mts., Great Falls, Columbia Falls, Aug. (80, 85).

Amblystegium filicinum (L.) De Not. Belt Mts., Great Falls, Columbia Falls, June (1).

Amblystegium filicinum trichodes (Brid.) Steudel. Columbia Falls, in dryer places than the preceding (334).

Amblystegium noterophilum (Sulliv.) Holzinger. Giant Spring, Great Falls (92).

Amblystegium riparium (Hedw.) Br. & Sch. Belt Mts., Great Falls, Columbia Falls, June (79).

Hypnum Halleri Linn. fil. Nyack and Essex, G. N. Ry., Aug. (349).

Hypnum hispidulum Brid. Columbia Falls, Aug. (229).

Hypnum chrysophilum Brid. Belt Mts., Columbia Falls, June (176, 199).

Hypnum stellatum Schreb. South Fork Flathead River, Columbia Falls, Aug. (201).

Hypnum internedium Lindb. Columbia Falls. Stem sections of this plant show an outer wall of large, thin cells next several rows of thickened cells and a distinct central strand. In appearence it is much like *revolvens* and *Sendtneri* (414).

Hypnum uncinatum Hedw. Belt Mts., Columbia Falls, July (77).

Hypnum uncinatum symmetricum Ren. & Card. Columbia Falls, June (405).

Hypnum Sendtneri Schimp. Columbia Falls. This may be distinguished from *intermedium* by stem section, which show no distinct outer row of large, thin cells in the wall. It has a distinct central strand (290).

Hypnum capillifolium Warnst. Columbia Falls, in still water of old river channel (262). What I take to be a finely developed sterile form grows on muddy bottoms in still water (415).

Hypnum Kneiffii laxum Schimp. South Fork of Two-medicine River (436).

Hypnum polycarpon Bland. Columbia Falls, in water of swamp, June 18 (175).

Hypnum polycarpon tenue (Schimp.) Limpr. Columbia Falls (437).

Hypnum decipiens (De Not.) Limpr. Columbia Falls (411).

Hypnum falcatum Brid. Columbia Falls, South Fork Cut-bank Cr., July (352).

Hypnum crista-castrensis L. Belt Mts., Sept.; Columbia Falls (89).

Hypnum reptile Michx. Columbia Falls, on decayed logs, July (399).

Hypnum subimponens Lesq. Macdonald Lake, Columbia Falls, June (351).

Hypnum Vaucheri Lesq. Belt River and Tenderfoot Cr., Belt Mts., Great Falls, July. This species seems to fruit not uncommonly in Montana. The sporophyte has not before been described, I believe. The pedicel is up to 15 mm. high, capsule short-cylindric, about 2½ mm. long with lid, slightly curved and erect or nodding. Lid acute, its height about equalling basal diameter. Annulus broad, 2 or 3 rows of cells high. Two or 3 smooth cilia between segments. Spores slightly rough, up to .016 mm. (72).

Hypnum revolutum (Mitt.) Lindb. (*H. plicatile* Mitt.) Belt Mts., July; Two-medicine Lake, Essex, Columbia Falls (124).

Hypnum pratense Koch. Columbia Falls. Lax, sterile specimens growing in shallow water or damp hollows. The complanate leaves are usually distinctly serrulate towards apex (261).

Hypnum Lindbergii elatum Schimp. Columbia Falls, on wet, shady sand along river, July (206).

Hypnum Haldanianum Grev. Columbia Falls, Oct. (227).

Hypnum palustre Huds. Highwood Mts., Belt Mts., Sun River Cañon, Columbia Falls, July (74).

Hypnum styriacum Limpr. Belt Mts., Columbia Falls, Forty-mile Cr. and Cut-bank Cr., Blackfeet Ind. Reservation, 5,000 ft., Aug. Not before credited to North America. It is somewhat like a slender form of the preceding, with more distant, curved and spreading leaves. The leaves are also rather more pointed, often distinctly serrulate on margin below, and vein weaker, usually slightly forking above. The flowers are clustered along the stems, often 2 or 3 ♀ and 1 ♂, and the outer perigonial leaves are figured by Limpricht as distinctly 3-toothed, this character is variable however in authentic specimens received from J. Breidler, the original collector of the species in the Alps of Austria (400).

Hypnum arcticum Sommerf. Observation Mts., Blackfeet Ind. Reserv., Macdonald Lake, Aug. This is a rather slender species with nearly round entire leaves, about 1 mm. in diameter and stout costa mostly extending well up above the middle of the leaf and not forked or only slightly so in the upper part (387).

Hypnum dilatatum Wils. Neihart, Belt Mts., 5,000 ft. This species is somewhat larger than the preceding with mostly a little narrower, somewhat pointed leaves, a much shorter, forking costa and a distinct cluster of enlarged alar cells. The leaves are close together on the stems, somewhat decurrent and up to about 2 mm. long. Branch leaves sometimes distinctly serrulate. Capsule with distinct annulus of

two rows of cells. Segments separated by mostly 2 well-developed cilia. Spores .018 mm. (409).

Hypnum Bestii Renauld. Belt Mts., Essex, G. N. Ry., Cut-bank Cr., Columbia Falls, 4,000 to 6,000 ft. (166, 410).

Hypnum ochraceum Turn. Belt Mts., Two-medicine Lake and Forty-mile Cr., Blackfeet Ind. Reservation, Macdonald Lake, Essex, G. N. Ry., Aug. The specimens are rather more slender than the typical form (381).

Hypnum scorpioides L. Columbia Falls (200, growing in marsh, 438, in shallow water of lake.

Hypnum robustum Hook. Columbia Falls (439).

Hypnum cordifolium Hedw. Two-medicine Lake, Macdonald Lake (318).

Hypnum giganteum Schimp. According to Limpricht the typical form of this plant has long, erect stems, short branches without branchlets and stem leaves averaging about 3 by 2 or 2¼ mm. It is apparently the most commonly fruiting form. Belt Mts., Cut-bank Cr., Columbia Falls, July (160). Variety *fluitans* Klinggr., much resembles *Fontinalis antipyretica gigantea* and grows in similar situations to that, with leaves up to 4½ by 3 mm. From this remarkably large leaf there are all intergradations down to leaves scarcely 1 mm. long, the latter growing in hollows, some seasons filled with water, at others wholly without standing water. Limpricht describes var. *brevifolium* with leaves nearly uniform in size on the stems, often almost round and 1½ to 2 mm. long. This evidently is the same as *H. cyclophyllotum* Holzinger, described three years earlier and I include Montana specimens under this name.

Hypnum giganteum cyclophyllotum (Holzinger). Here might well be placed all the shorter, more or less round-leaved forms, with leaves varying from 1 to 2 mm. in length and often nearly or quite as broad. Columbia Falls, margin of pond, July (263).

Hypnum giganteum dendroides Limpr. Plants with lower branches often long, and all the branches with more or less numerous branchlets. The stem leaves are comparatively

long and narrow, $3\frac{1}{2}$ by $1\frac{3}{4}$ to 2 mm., in this respect approaching *cordifolium*, but they have the abruptly inflated alar cells of *giganteum*. Belt Mts., Columbia Falls (219).

Hypnum Schreberi Willd. Belt Mts., Columbia Falls, April (126).

Hylocomium proliferum (L.) Lindb. Belt Mts., Columbia Falls, May (90).

Hylocomium squarrosum (L.) Br. & Sch. Head of Macdonald Lake (357).

Hylocomium triquetrum (L.) Br. & Sch. Belt Mts., Columbia Falls, April (126).

Hylocomium loreum (L.) Br. & Sch. Macdonald Lake, Columbia Falls (202).

Description of Plates.

Camera lucida drawings reproduced without reduction.

PLATE 34. *Dicranum hispidulum.*

Fig. 1. Plant about natural size.
Figs. 2 and 3. Stem leaves, × 34.
Fig. 4. Inner perichaetial leaf, × 34.
Fig. 5. Antheridial bud.
Figs. 6 and 7. Cross-sections of leaf, 6 × 285 and 7 × 400.
Fig. 8. Part of base of stem leaf, × 160.
Fig. 9. Median cells of stem leaf, × 160.
Fig. 10. Apex of leaf, × 160.
Fig. 11. Cross-section of stem, × 285.
Fig. 12. Capsule and 13, calyptra, × 16.
Fig. 14. Part of peristome and annulus, × 285.

PLATE 35. *Seligeria campylopoda.*

Fig. 1. Plants about natural size.
Fig. 2. Plant enlarged, × 35.
Fig. 3. Lid, × 35.
Fig. 4. Inner perichaetial leaf, × 35.
Fig. 5. Stem leaf below, × 35.
Fig. 6. Calyptra, × 35.
Fig. 7. Part of peristome, × 175.
Fig. 8. Antheridium with leaf and paraphyses.
Fig. 9. Middle stem leaf, × 42.
Fig. 10. Apex of leaf, × 200.
Fig. 11. Part of base of leaf, × 200.

PLATE 36. *Barbula perannulata.*

Fig. 1. Plant about natural size.
Fig. 2. Calyptra enlarged.
Fig. 3. Peristome enlarged.
Fig. 4. Inner perichaetial leaf, × 25.
Figs. 5, 6, 7, 8. Stem leaves, × 25.
Fig. 9. Annulus, × 160.
Fig. 10. Capsules, × 10.
Fig. 11. Perichaetium, × 20.
Fig. 12. Exothecal cells at mouth of capsule, × 300.
Fig. 13. Stoma, × 160.
Fig. 14. Apex of leaf, × 300.
Fig. 15. Part of base of leaf, × 160.

PLATE 37. *Merceya latifolia.*

Fig. 1. Plant about natural size.
Figs. 2 and 3. Lower and upper stem leaves, × 8.
Fig. 4. Cross-section of stem, × 80.
Fig. 5. Cross-section of leaf near margin, × 205.
Fig. 6. Cross-section of costa and part of leaf, × 205.
Fig. 7. Leaf-cells ⅓ down from apex in margin, × 205.
Fig. 8. Apex of leaf, × 205.

PLATE 38. *Bryum Williamsi.*

Fig. 1. ♀ and ♂ plants about natural size.
Fig. 2. Stem leaves, × 16.
Figs. 3 and 4. Inner and outer perichaetial leaves.
Fig. 5. Antheridium and two leaves.
Fig. 6. Apex of stem leaf, × 285.
Fig. 7. Alar region of leaf, × 285.
Fig. 8. Marginal cells ½ down leaf, × 285.
Fig. 9. Part of peristome, annulus and exothecal cells, × 205.
Fig. 10. Stoma, × 285.
Fig. 11. Capsules, × 10.

PLATE 39. *Buxbaumia Piperi.*

Fig. 1. Plants about natural size.
Fig. 2. Capsules showing outline from above.
Fig. 3. Leaf, × 160.
Fig. 4. Part of peristome, × 160.
Fig. 5. Vertical section through the upper part of capsule and peristome; *A*, large cells forming the pseudo-annulus; *B*, inner and outer peristome. *C*, Outer wall of capsule, × 100.
Fig. 6. ♂ plant, × 300.
Fig. 7. Antheridium, × 300.
Fig. 8. Stoma, × 285.

Geological and Botanical Notes: Cape Cod and Chappaquidick Island, Mass.

[Investigations prosecuted with the aid of a grant from the John Strong Newberry Fund of the Council of the Scientific Alliance of New York.]

BY ARTHUR HOLLICK.

(PLATES 40 and 41.)

I. INTRODUCTION.

About twelve years ago the writer began the task of systematically exploring the remnants of the old Atlantic coastal plain from Staten Island eastward along the southern New England coast, with the special object of locating any exposures of Cretaceous strata; tracing and examining these critically; collecting specimens, and, from the facts ascertained, endeavoring to determine the probable former position and extent of the formation throughout the region. These investigations, continued from year to year, finally included Staten Island, Long Island, Block Island, Martha's Vineyard, the Elizabeth Islands and Nantucket and resulted in a series of papers on the geology and botany of these localities, most of which were read before the New York

Academy of Sciences and published in its Transactions or Annals or in the Bulletin of the Torrey Botanical Club.*

In order that final conclusions might be deduced, however, it was necessary that two additional localities should be visited, *i. e.*, Cape Cod, and Chappaquidick Island at the eastern end of Martha's Vineyard. These were made the objective points in a trip last year, during the latter part of August and early part of September, and the field notes then taken, together with the specimens collected, form the basis of this communication.

II. CAPE COD.

1. General Description.

"Cape Cod," as metaphorically described by Thoreau, "is the bared and bended arm of Massachusetts: the shoulder is at Buzzard's Bay; the elbow or crazy-bone at Cape Malle-

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* 1. The Paleontology of the Cretaceous Formation on Staten Island. Trans. N. Y. Acad. Sci. **11**: 96–104. 1892.

2. Additions to the Paleobotany of the Cretaceous Formation on Staten Island. Ibid. **12**: 28–39. 1892.

3. Additions to the Paleobotany of the Cretaceous Formation on Staten Island, No. II. Ann. N. Y. Acad. Sci. **11**: 415–430. 1898.

4. Some Features of the Drift on Staten Island, N. Y. Ibid. **12**: 91–182. 1899.

5. Plant Distribution as a Factor in the Interpretation of Geological Phenomena, with Special Reference to Long Island and Vicinity. Trans. N. Y. Acad. Sci. **12**: 189–202. 1893.

6. Preliminary Contribution to Our Knowledge of the Cretaceous Formation on Long Island and Eastward. Ibid. 222–237.

7. Additions to the Paleobotany of the Cretaceous Formation on Long Island. Bull. Torrey Club, **21**: 49–65. 1894.

8. Some Further Notes on the Geology of the North Shore of Long Island. Trans. N. Y. Acad. Sci. **13**: 122–129. 1894.

9. Geological Notes: Long Island and Nantucket. Ibid. **15**: 3–10. 1896.

10. Observations on the Geology and Botany of Martha's Vineyard. Ibid. **13**: 8–22. 1893.

11. Dislocations in Certain Portions of the Atlantic Coastal Plain Strata and Their Probable Causes. Ibid. **14**: 8–20. 1894.

12. Geological Notes: Long Island and Block Island. Ibid. **16**: 9–18. 1896.

13. Notes on Block Island. Ann. N. Y. Acad. Sci. **11**: 55–88. 1898.

14. A Reconnoissance of the Elizabeth Islands. Ibid. **13**: 387–418. 1901.

barre: the wrist at Truro; and the sandy fist at Provincetown."

The cape as a whole has been so thoroughly and ably described and its features discussed, by Warren Upham,* W. O. Crosby,† W. M. Davis‡ and other more recent writers, and it has been utilized so frequently in text-books for examples of sea beach and shore topography and sculpture, that any extended description here would be superfluous, and it will probably be sufficient to merely recall that, geologically, the cape may be regarded as consisting of two parts: a relatively old one, extending from the Highlands of Truro southward, composed of morainal and modified drift material and a more recent one, represented by the beaches and sand dunes of Provincetown, and other smaller but similar areas elsewhere, which have been built up by wave and wind action from the eroded material of the older part.

2. The Highlands of Truro.

According to the information which I had been able to obtain from published reports the Highlands of Truro appeared to be the part of the cape in which Cretaceous material would most likely be found, and my efforts were therefore concentrated in that vicinity.

These highlands represent the northernmost remnants of the original land from which the cape was developed into the form in which we know it to-day. They are a portion of the morainal ridge, with elevations of one hundred to one hundred and sixty feet above tide, and are composed of beds of clay, sand and gravel, with occasional bowlders. In regard to their general structure and the arrangement of the material, they may be compared with the northern or more recent branch of the terminal moraine, as represented on Orient

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* The Formation of Cape Cod. Am. Nat. 13: 489–502, 552–565. 1879.

† On the Occurrence of Fossiliferous Boulders in the Drift of Truro, on Cape Cod, Mass. Proc. Boston Soc. Nat. Hist. 20: 136–140. 1879.

‡ The Outline of Cape Cod. Proc. Am. Acad. Arts and Sci. 31: 303–332. 1896.

Point, Long Island, and the Elizabeth Islands. The strata are not contorted as they are in the southern or older branch; water-assorted material preponderates over glacial till and bowlders are relatively not abundant.

At the time of my visit there was no exposure of any basal clays in the moraine or any indications of any which might be considered as older than those which were evidently deposited as morainal or modified drift material and I failed to find a vestige of any rock or a trace of any fossil which could be even provisionally referred to the Cretaceous formation, although the face and talus slopes of the bluffs in the vicinity of the lighthouse were carefully searched for several miles in either direction.

I was led to hope that this locality, if any, would give some evidences or indications of the former existence of Cretaceous strata in the vicinity for the reason that Upham mentions (*l. c.*, p. 560) having found lignite and "clay bowlders," which latter he describes as "changed to a brown color for a depth of half an inch from the outside, due to oxidation of the iron,"—a description which quite accurately fits the material in which Cretaceous molluscs and plant remains occur so abundantly in connection with the moraine on Long Island, Block Island, Martha's Vineyard and elsewhere. Further than this, in the same article, he also notes the discovery of "an *Anomia* similar to *A. tellinoides* Morton, of the Cretaceous in New Jersey, Alabama and Mississippi."

The above memoranda were of course exceedingly meager and unsatisfactory evidence of the presence of Cretaceous material, and my failure either to verify my interpretation of the facts or to add any new ones was perhaps to be expected. We may say, therefore, so far as the evidence now in our possession is concerned, that no satisfactory identification of Cretaceous material has yet been made from any locality east of Buzzard's Bay or Martha's Vineyard, for such identification is also lacking in regard to any specimens reported from the island of Nantucket.

Tertiary and more recent molluscs have been found and satisfactorily identified, in considerable numbers, in the vicinity of Truro, as recorded by both Upham and Crosby, and it is perhaps significant in this connection to note that the well-known greensand bed at Marshfield, on the opposite shore of Cape Cod Bay, which was originally described by N. S. Shaler as middle Cretaceous in age,* is now considered by him to be Miocene Tertiary,† apparently without question.

Although the main object of my search was not attained, it may be of interest to record, incidentally, the discovery, near the lighthouse, of a bowlder of red shale, of Cambrian age, containing numerous trilobite and other remains. My attention was first attracted to it on account of its similarity in superficial appearance to the ferruginous nodules of Cretaceous clay, previously mentioned. It was lying in the talus and a single blow with the hammer caused it to break into a number of small pieces. Some of these were submitted to Mr. G. F. Matthew, of the Canadian Geological Survey, to whom I am indebted for the following note.

"* * * The fauna is evidently that of the Etcheminian red shale of the Boston basin of Cambrian rocks. The fossils are in a good condition of preservation; the shale is soft, and if you could find the original bed, no doubt a good series of fossils could be obtained." His identifications include the genera *Microdiscus*, *Olenellus*, *Agraulos*, *Strenuella* and *Hyolithes*.

Other fragments were submitted to Mr. Gilbert Van Ingen, of the New York State Museum, from whose communication in relation to them I quote as follows:

"* * * Two of the species are trilobites of lower or middle Cambrian horizons: one is certainly *Microdiscus* the other appears to be an *Olenellus*, but which species I can not yet say. The material is fine and I should like to see the ledge from which the fragment was originally removed."

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* Bull. Geol. Soc. Am. 1 : 447. 1890.

† Ann. Rept. U. S. Geog. Surv. 17 : Pt. I., 962. 1895–96.

Similar bowlders have been found on the mainland of eastern Massachusetts, but so far as I am informed, the location of the outcrop from which they were derived has not been satisfactorily ascertained. This problem is an interesting one and its correct interpretation would materially assist in determining the exact direction of glacial movement in that region.

Those who may be interested in the general subject of the Cambrian rocks of the adjacent mainland will find an excellent contribution, with numerous references to other authors, by A. W. Grabau, under the title "Palaeontology of the Cambrian Terranes of the Boston Basin."*

3. Provincetown.

(*a*) *Geology.*

From the Highlands of Truro, northward and westward around to the extreme end of the cape, lie the sand dunes and beaches of Provincetown, embracing an area approximately six miles long by an average of two miles wide, and including hills which reach elevations of ninety feet and more above tide, every natural feature of which region is a product of wave or wind action in recent geologic time, that is, since the close of the Ice Epoch.

A study of these features is exceedingly instructive, not only for the reason that they supply such obvious indications of the manner in which the forces of nature have acted in the past but also because they afford such striking examples of what is taking place at the present time. Many of the phenomena of erosion and transportation are so perfectly apparent and easy of interpretation that any observer can hardly fail to be impressed by them and to me they appealed irresistibly, on account of the intimate relations which were seen to exist between the geological and botanical factors involved.

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* Occasional Papers, Boston Soc. Nat. Hist. 4: Pt. III., 601–694. *pl. 31–39.* 1900.

The sequence of events which has resulted in the formation of this area of land was evidently identical with that which is adding to it to-day. It is doubtful in fact if there has been any interruption since the time when the first shoal or sand bar began to form north of the Highlands of Truro, except such as has been caused by the influence of man. This sequence evidently began with the erosion of the older part of the cape, or, more correctly, of the land which now forms the cape. The prevailing northward trend of the tides and currents transported the eroded material to and beyond the northern extremity of the land, where it was dropped in the slack water of the currents as they swept around into Cape Cod Bay. A submarine shoal or bank was thus formed, which subsequently developed into a sand spit, extending out from the original land. This continued to extend northward and westward, following the curve of the currents, while its older part was being built up permanently, above the level of the highest tides, by wave and wind action. It also began to extend laterally by reason of the sand drifting in the direction of the prevailing winds. In the slack water on the inner side of the sand spit the tide continued to ebb and flow for a greater or less length of time, but finally it became silted up and converted, first into tidal flats and subsequently into a salt marsh, which was eventually obliterated, either wholly or in part, by drifting sand and covered to a greater or less extent by dunes.

On the accompanying map (Plate 40) the principal surface and submarine features are indicated, in order to illustrate how these successive steps in land formation have taken place. The twenty-foot contours above ocean level are shown and most of the higher points within these contours are noted by figures, while many of the depressed areas are represented by the recognized topographic signs for swamps or ponds as the case may be, where such exist. The surrounding submarine area, where shoals or bars are now forming, or have formed in recent years, is also included. Changes, both on land and under water, are constantly taking place

however, and although this map was prepared from the latest available maps of the United States Geological and Coast Surveys, it must be considered as merely indicating the directions in which the waves and winds have worked in the past and how they may be expected to work in the future, so far as adding to the land area or modifying its topography is concerned.

At the present time the sand spit stage is well represented by Race Point and Long Point, while Race Run and the inner portion of Provincetown Harbor represent areas that are rapidly becoming converted from tidal flats into marshes. The former location of the head of Race Run is plainly indicated by the depression which lies between the present outer line of low dunes along the beach and the twenty-foot contour parallel with them, which latter represents approximately the former shore line, at a time when there was nothing but a spit or bar where the present shore line is now. Further than this, if the submarine conditions are studied it may be seen that several bars are in process of formation north of and parallel with the shore, which, reasoning from our premises, are probably destined to coalesce, form a spit, and eventually to become a new outer coast line, with a "run" on the inner side.

That the whole of the existing land, from the Highlands of Truro northward has been built up in this way, by successive series of such phenomena, could hardly be questioned even if no other evidence were available than that offered by the surface features, but additional evidence is afforded by an examination of the character and arrangement of the material which forms the land. Every particle is water-worn sand or gravel or cobble stones. The latter two constituents evidently represent the coarser beach shingle and they do not occur anywhere above the level of high tide. They never enter into the composition of the hills, although they are known to be beneath them in many localities. The sand represents the finer material and only such particles as are fine enough to be transported by the wind are ever found

in connection with the hills, which are evidently merely heaps of sand blown from the original beaches and are necessarily quite uniform in composition.

The constant extension of the land northward and westward as above outlined, is of course just so much land area gained, but as it is of no particular commercial value it would probably be regarded with more or less indifference by the inhabitants of Provincetown, except for the reason that it furnishes a constantly increasing amount of sand for the winds to carry southward and eastward towards the town and harbor, and that this constitutes a real and ever-present menace is perfectly apparent and is thoroughly appreciated by everyone who has property interests at stake there. A dune, eighty or ninety feet in height, the crest of which is seen to be advancing at a rate of ten or fifteen feet a year; a pond or swamp which has been filled up and blotted out of existence by drifting sand; a deep wind cut where a ridge formerly existed; trees and bushes partly or entirely buried, etc., are object lessons which all may see and few may ignore, and these or similar phenomena have been observed and their significance understood for a number of generations.

Doubtless had man not interfered with the processes of nature, by destroying vegetation, wind action would not have the same importance which it has to-day as a factor in the domestic and political economy of Provincetown, but such destruction has been wrought, unfortunately, and the sequence of cause and effect in this connection is so well recognized that systematic effort is now being made to protect and preserve what remains of the vegetation and to re-clothe the denuded areas, as will be discussed further on.

(*b*) *Botany*.

The flora is quite limited, not only in its distribution but also in the number of species represented. The trees and shrubs, with their accompanying shade-loving herbaceous plants, are practically all included in a zone, averaging less than a mile in width, extending along the shore of Province-

town Harbor. North of this zone the hills are bare except for the few species characteristic of barren sand dunes. Judging from the early descriptions of the region however there seems to be no question that the flora was once far more abundant both in numbers and in species than it now is, and apparently we must regard that which we now find there as merely the remnants of that which once prevailed.

In William Bradford's account of the landing of the pilgrims from the "Mayflower," in Provincetown harbor, Nov. 11, 1620, he says in his journal:

"On this side where we lay is the bay, and on the further side the sea; the ground or earth, sandhills, much like the Downes in Holland, but much better; the crust of earth a spit's depth, excellent black earth; all wooded with oaks, pines, sassafras, juniper, birch, holly, vines, some ash, walnut; the wood for the most part open and without underwood, fit either to go or ride in."

This account would apparently indicate the presence of a forest of tall trees, largely deciduous and totally different from the stunted growth, almost exclusively consisting of pines and oaks, which are now almost the sole representatives of the arborescent flora.

This condition did not last very long however, if we may judge from the subsequent records of the colony, as may be seen from the following preamble to Chapter 3 of the Acts of 1714:

"Whereas, the harbor of Cape Cod, being very useful and commodious for fishing, and the safety of shipping, both inward and outward bound, is in danger of being damnified, if not made wholly unserviceable, by destroying the trees standing on the said cape (if not timely prevented), the trees and bushes being of great service to keep the sand from being driven into the harbor by the wind. Be it enacted," etc., while in 1740 there was passed "An Act to prevent damage being done to the harbor of Cape Cod by cattle and horse-kind feeding on Provincetown land."

Subsequently probably a dozen or more similar acts were passed and thousands of dollars were expended by the State and National governments in the attempt to prevent further destruction of the vegetation and to reclaim the areas denuded.

At the present time, not only is the cutting ot timber and the burning of underbrush prohibited, but the people are even required to keep to the established roads in order not to wear away any of the low herbaceous growth and thus perhaps to cause a bare spot which might be the starting point for a wind cut. Warning notices are everywhere posted through the woods, and on Town Hill, a dune one hundred feet high, well within the limits of the town, may be seen the following notice: " All persons are forbidden travelling up or down this hill excepting in the public road."

So far as measures for re-foresting are concerned these have hardly progressed for a sufficient length of time to judge fairly of their ultimate success. Under the State Act known as Chapter 420 of the Laws of 1892 the Trustees of Public Reservations were directed to prepare a map of the Province Lands, collect information, and make suggestions for their future care and preservation. Their report, made to the Legislature of Massachusetts, was published as House Document No. 339 (Feb., 1893) and may also be found included, as Appendix III., in the Second Annual Report of the Trustees of Public Reservations [Mass.] for 1892, issued in 1893. In this report they suggest that the management of the lands should be placed in the hands of the Board of Harbor and Land Commissioners, which was subsequently done, and experiments were at once instituted to ascertain what kinds of vegetation would be best suited to the dunes, in order that they might be re-forested and the drifting of sand prevented. Unfortunately I could not secure definite information in regard to the earlier attempts at planting, but from information obtained from unofficial sources and judging from the remnants of some abandoned plantations, the first vegetation which it was sought to establish was apparently largely of introduced species of pines (*Pinus sylvestris* L.?) and Scotch broom (*Cytissus scoparius* (L.) Link.). These were not a success, however, as they were either winter-killed or else were smothered by the sand and those who had the matter in charge finally decided to follow the sequence indicated by

nature in her successive plant formations, when new land is formed. This consists in first of all establishing a growth of beach grass (*Ammophila arenaria* (L.) Link.), which may be readily transplanted and which continues to grow upward through any sand drifted over it. Several hundred acres were thus planted and apparently with complete success. Patches of bay (*Myrica Carolinensis* Mill.) were next introduced here and there, which took hold at once, and finally young pines (*Pinus rigida* Mill.) were planted and seeds scattered amongst the tufts of grass and in the shelter of the patches of bay or in ground protected by layers of brush. At the time of my visit the areas so planted showed every indication of success and, in addition, in many places a natural growth of *Euphorbia polygonifolia* L., *Artemisia caudata* Michx., *Polygonella articulata* (L.) Meissn., and other sand-loving species, had become well established.

In this connection the questions have been asked: Why, if it is the fact that a vigorous forest growth once covered the region, should it be difficult to reëstablish it, and why should that which yet remains show no apparent indication of ever becoming equal to that which preceded it?

The same questions were advanced in regard to Block Island and other localities, where similar conditions prevail, which has led me to think that perhaps the matter may not have received the attention which it deserves.

At first sight an adequate answer might not be apparent, but when the former geologic or physiographic conditions are considered the reasons are quite obvious. In the case of Block Island for example there is no doubt that the original forest growth was established at a time when the island, as such, did not exist; when what we now know merely as a small, isolated, wind-swept island was part of an extensive land area, connected with the adjacent mainland, and therefor not subject to the vicissitudes of wind and weather which now prevail.

In the case of Provincetown also the original conditions were totally different from the present ones. The building

up of the land was a slow process, considered from the standpoint of human events; so slow that when any portion became permanently established as dry land the growth of vegetation could and did readily keep pace with the growth of the land. As the spits extended the several plant formations kept pace with them, secured footholds and prevented any extensive drifting of the sand. In this way a permanent growth was gradually established, consisting of the species which were in existence on the original land, and as long as these conditions continued no extensive bare or barren areas could be formed either by constructive or destructive forces. Any interference with this growth, however, such as by cutting or burning, would at once expose the sand to wind action, and the destruction would be both direct and indirect: directly from the cutting or burning, indirectly by reason of the sand drifting from the denuded areas and smothering vegetation elsewhere. The work of nature would thus have to begin all over again and in connection with areas generally far greater in extent than existed at any previous period. Such are the conditions at Provincetown, and there can hardly be any question that the principal trouble there, from drifting sand, is directly traceable to the areas denuded by man of their former natural covering, and not to the recently formed beaches or other naturally naked areas.

It should also be remembered that when any species becomes extinct in a region where changes in environment are taking place, as has been the case throughout the entire extent of Cape Cod, its subsequent reëstablishment under the changed conditions may be exceedingly difficult or impossible, and this is the obvious explanation of the limited number of species in the flora of Provincetown at the present time.

Further than this, one point which has apparently escaped attention in the work of re-foresting merits careful consideration. In the desire to produce immediate results and to attack the most obvious sources of danger first, the work is really proceeding in a direction more or less contrary to that of nature. Under natural conditions the primary region in

which vegetation becomes established is along the shore line and the vegetation tends to drift or spread from thence inland in the direction of the prevailing winds. The work now under way, however, has been started in localities some distance from the shore, and in any effort of the vegetation to spread naturally it must do so in part against the wind. Doubtless the immediate binding of the sand in the worst places is the main object to be considered, but when that has been accomplished the method indicated by nature should be carefully noted and utilized as far as possible. The attempt to work from the interior back to the shore is certainly in opposition to this method.

In accordance with environment the vegetation may be divided into two main groups: that of the forested areas and that of the bare sands: The bulk of the trees consists of *Pinus rigida* Mill., *Quercus rubra* L., and *Q. velutina* Lam., with scattered patches and individuals of *Betula populifolia* Marsh., *Fagus Americana* Sweet, *Prunus serotina* Ehrh., *Acer rubrum* L., and *Nyssa sylvatica* Marsh.

The underbrush is largely *Viburnum venosum* Britton, *Gaylussacia resinosa* (Ait.) T. & G., *Vaccinium Pennsylvanicum* Lam., *Kalmia angustifolia* L., *Rhus copallina* L., *Prunus maritima* Wang., *Amelanchier Botryapium* (L. f.) DC., *Aronia arbutifolia* (L.) Medic., *A. nigra* (Willd.) Britton, *Rosa lucida* Ehrh., and *Myrica Carolinensis* Mill., and in the low swampy areas, *Clethra alnifolia* L., *Azalea viscosa* L., *Ilex glabra* (L.) A. Gray, *Spiraea tomentosa* and *S. salicifolia* L. *Arctostaphylos Uva-Ursi* (L.) Spreng., is omnipresent, which, together with *Corema Conradii* Torr. and *Rubus hispidus* L., are important factors in the formation of a close, coarse vegetable turf or mat, which covers and protects the sands in semi-denuded areas. *Agrostis hyemalis* (Walt.) B.S.P., and *Danthonia spicata* (L.) Beauv., occur in sufficient abundance, along the borders of and in the more open woods, to attract attention, while the remaining herbaceous vegetation includes, as prominent elements, *Pteridium aquilinum* (L.) Kuhn, *Polygonum scandens* L., *Aralia*

nudicaulis L., *A. hispida* Vent., *Chimaphila maculata* (L.) Pursh, *Gaultheria procumbens* L., *Gerardia purpurea* L., *Hieracium Marianum* Willd., *H. Canadense* Michx., *H. scabrum* Michx., *Nabalus serpentarius* (Pursh) Hook., *Solidago bicolor* L., *S. puberula* Nutt., *S. odora* Ait., *S. rugosa* Mill., *S. nemoralis* Ait., *Euthamia Caroliniana* (L.) Greene, *Sericocarpus asteroides* (L.) B.S.P., *Aster divaricatus* L., *A. undulatus* L., and *A. ericoides* L.

In the vicinity of habitations several introduced species have escaped to a considerable extent, such as *Saponaria officinalis* L. and *Euphorbia Cyparissias* L., both of which are particularly abundant in and around the old cemetery.

In connection with the bare sands we may note two quite well defined plant formations: that of the beach and that of the dunes. *Ammodenia peploides* (L.) Rupr., *Cakile edentula* (Bigel.) Hook., *Lathyrus maritimus* (L.) Bigel., *Euphorbia polygonifolia* L., and *Xanthium echinatum* Murr., are typical beach species, which are capable of becoming established in the pure beach sand, down to the very edge of high-water mark. Mixing with the inner border of this vegetation is *Salsola Kali* L. and *Solidago sempervirens* L., and then begins the typical dune flora, in which *Ammophila arenaria* (L.) Link. is the most prominent element. Associated with this are occasional large patches of *Hudsonia tomentosa* Nutt., clumps of *Myrica Carolinensis* Mill., and *Prunus maritima* Wang., and in less abundance but more widely scattered, *Cyperus Grayi* Torr., *Polygonella articulata* (L.) Meissn., *Lechea maritima* Leggett, *Onagra Oakesiana* (A. Gray) Britton and *Artemisia caudata* Michx. In low-lying, wet areas, such as at the head of Race Run, this merges into a characteristic sub-formation, consisting largely of *Juncus Greenii* Oakes & Tuckm., *J. Canadensis* J. Gay, *Scirpus Americanus* Pers., and *Salicornia herbacea* L. and when such areas become converted into fresh-water swamps these species are replaced by *Eleocharis ovata* (Roth.) R. & S., *E. acicularis* (L.) R. & S., *Fimbristylis autumnalis* (L.) R. & S., *Xyris Caroliniana* Walt., *Eriocaulon septangulare*

With., *Oxycoccus macrocarpus* (Ait.) Pers., *Lycopus rubellus* Moench, *Ilysanthes dubia* (L.) Barnhart, etc.

A list of the ninety-four species collected is appended which is to be regarded as merely indicating those which were most abundantly represented or most conspicuous and therefore as characteristic of the locality. Probably the only one in the list which merits any special mention is *Corema Conradii* Torr., which apparently has not been reported from Provincetown since the time of Thoreau's visit, in 1849, when he found it near the lighthouse of Truro, and says: "I saw it afterwards in Provincetown." It was also collected at Truro in July, 1886, by J. H. Redfield, according to memoranda kindly transmitted to me by Dr. B. L. Robinson, of Harvard University.

List of Species.

Polypodium vulgare L.
Pteridium aquilinum (L.) Kuhn.
Pinus rigida Mill.
Agrostis hyemalis (Walt.) B.S.P.
Ammophila arenaria (L.) Link.
Danthonia spicata (L.) Beauv.
Cyperus Grayi Torr.
Eleocharis ovata (Roth.) R. & S.
Eleocharis acicularis (L.) R. & S.
Fimbristylis autumnalis (L.) R. & S.
Scirpus Americanus Pers.
Xyris Caroliniana Walt.
Eriocaulon septangulare With.
Juncus bufonius L.
Juncus Greenii Oakes & Tuckm.
Juncus Canadensis J. Gay.
Unifolium Canadense (Desf.) Greene.
Salomonia biflora (Walt.) Britton.
Smilax rotundifolia L.
Salix fragilis L.
Myrica Carolinensis Mill.
Betula populifolia Marsh.
Fagus Americana Sweet.
Quercus rubra L.
Quercus velutina Lam.
Polygonum scandens L.
Polygonella articulata (L.) Meisn.
Salicornia herbacea L.
Salsola Kali L.
Silene noctiflora L.
Saponaria officinalis L.
Ammodenia peploides (L.) Rupr.
Tissa rubra (L.) Britton.
Cakile edentula (Bigel.) Hook.
Spiraea salicifolia L.
Spiraea tomentosa L.
Rubus hispidus L.
Potentilla argentea L.
Rosa lucida Ehrh.
Aronia arbutifolia (L.) Medic.
Aronia nigra (Willd.) Britton.
Amelanchier Botryapium (L.f.) DC.
Prunus maritima Wang.
Prunus Pennsylvanica L.f.
Prunus serotina Ehrh.
Lathyrus maritimus (L.) Bigel.
Euphorbia polygonifolia L.
Euphorbia Cyparissias L.
Corema Conradii Torr.
Rhus copallina L.
Ilex glabra (L.) A. Gray.
Acer rubrum L.
Parthenocissus quinquefolia (L.) Planch.
Helianthemum majus (L.) B. S.P.
Hudsonia tomentosa Nutt.

Lechea maritima Leggett.
Onagra Oakesiana (A. Gray) Britton.
Aralia nudicaulis L.
Aralia hispida Vent..
Nyssa sylvatica Marsh.
Clethra alnifolia L.
Chimaphila maculata (L.) Pursh.
Azalea viscosa L.
Kalmia angustifolia L.
Gaultheria procumbens L.
Arctostaphylos Uva-Ursi (L.) Spreng.
Gaylussacia resinosa (Ait.) T. & G.
Vaccinium Pennsylvanicum Lam.
Oxycoccus macrocarpus (Ait.) Pers.
Lycopus rubellus Moench.
Ilysanthes dubia (L.) Barnhart.
Gerardia purpurea L.
Viburnum venosum Britton.
Hieracium Marianum Willd.
Hieracium Canadense Michx.
Hieracium scabrum Michx.
Nabalus serpentarius (Pursh) Hook.
Xanthium echinatum Murr.
Solidago bicolor L.
Solidago puberula Nutt.
Solidago sempervirens L.
Solidago odora Ait.
Solidago rugosa Mill.
Solidago nemoralis Ait.
Euthamia Caroliniana (L.) Greene.
Sericocarpus asteroides (L.) B.S.P.
Aster divaricatus L.
Aster undulatus L.
Aster puniceus L.
Aster ericoides L.
Aster ericoides pilosus (Willd.) Porter.
Leptilon Canadense (L.) Britton.
Gnaphalium uliginosum L.
Artemisia caudata Michx.

III. CHAPPAQUIDICK ISLAND.

1. General Description.

Chappaquidick Island, so-called, forms the eastern extremity of Martha's Vineyard, with which it is occasionally connected, but from which it is usually separated, according to the condition of the narrow isthmus-like beach which forms the barrier between Katama Bay and the Atlantic Ocean. During a larger part of the time there is an opening somewhere in this beach, but its position constantly shifts and at times it becomes closed and remains so for brief periods, or at others two openings may occur contemporaneously. At the date of my visit, last September, there was a single opening, close to Wasque Point, as shown in Fig. 1 on next page.

In N. S. Shaler's "Report on the Geology of Martha's Vineyard"* may be found a discussion of this phenomenon and also a report by Henry C. Whitney, with a map, describing the recession of the beach and the changes in position of the opening, based upon surveys made in connection

*Ann. Rept. U. S. Geol. Surv. 7: 297–363. *pls. 19–29* and *figs. 55–63.* 1888.

with the United States Coast Survey, between the years 1846 and 1886 (*l. c.*, 361–363, *fig. 62*).

From the observations recorded there appears to have been a systematic sequence of events in connection with these

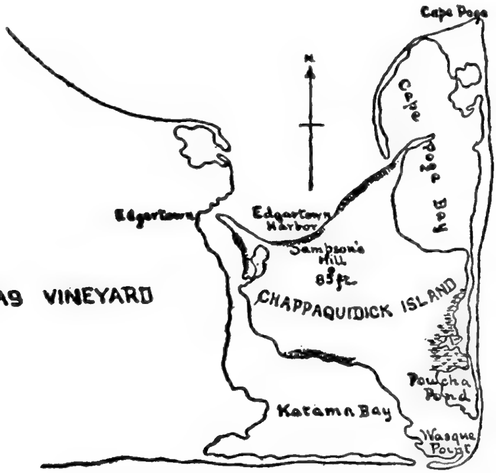


FIG. 1.

changes, due to the fact that the prevailing direction of the shore currents is there from west to east, thus building up and extending the beach at the western side of any opening and forcing the tidal currents over to the eastern side, which is by this means constantly eroded. The opening is thus shifted further and further eastward until it reaches Wasque Point, when it can go no further and finally becomes closed, when a new opening forms at the western end of the beach or this latter may form before the other has ceased to exist.

Topographically the island consists of a collection of rounded, irregularly disposed hills, bordered on the south and east by narrow areas of sea beach. The maximum elevation is about eighty-five feet, at Sampson's Hill. Steep bluffs, twenty to forty feet high, are exposed at several localities along the shores of Katama Bay and Edgartown Harbor and an elevation of forty feet is reached a short distance from the shore, on Cape Poge, but in the eastern portion of

the island proper the surface is comparatively level and undulating and the shore line is low, with a limited area of salt marsh in the vicinity of Poucha Pond, and smaller ones at other points, in connection with little tidal inlets.

2. Geology.

If the recently transported sands of the beaches are disregarded the island may be said to be composed of reassorted drift, with occasional boulders and a very limited amount of till. Inasmuch as the island is located approximately five miles south of the frontal moraine of Martha's Vineyard and is more or less out of the line of its apparent trend at Vineyard Haven, which is the nearest point at which it is now exposed, the presence of this small area of till is somewhat difficult to understand. There is, however, an unmistakable exposure along the low western shore of Cape Poge Bay and another on Cape Poge, which exposures may perhaps represent the sloping southern edge of the moraine, which evidently once extended in a southeasterly direction from Vineyard Haven to Nantucket. I was unable, however, to determine the relations of these exposures to the reassorted material of the nearby hills.

These hills in general may be described as kame-like, both in appearance and in composition. They are rounded accumulations of sand, gravel and cobble stones, with some bowlders, and were evidently formed by water action. In many places the sand and gravel is cemented together by limonite, forming hard lenses or strata, and ferruginous concretions and shaly fragments are abundantly represented, especially on the shores and in the bluffs fronting on and adjacent to Edgartown Harbor.

3. Paleontology.

This ferruginous material was at once recognized as lithologically identical with that in which Cretaceous molluscs and plants had been found on Martha's Vineyard and elsewhere, and the mention by Shaler of the occurrence of obscure mol-

luscan remains in this matrix on Chappaquidick * encouraged me to hope that careful search might bring some specimens to light which could be identified. A systematic exploration of all exposures was therefore prosecuted; hundreds of the concretions and shaly fragments were broken open and critically examined and the result was a collection, not only of molluscs but also of plant remains, a few of which were found sufficiently well preserved for identification.

(*a*) *Molluscs.*

The molluscs as a whole are poor specimens and are not satisfactory subjects from which to deduce any definite conclusions. They were first submitted to Professor R. P. Whitfield, of the American Museum of Natural History, who kindly examined them and from whose report upon them I quote as follows:

"I have examined the fossils you sent the other day but I cannot satisfy myself as to their age. They consist of a *Modiola*, which apparently does not differ from our common *M. plicatula* of the harbor here; an *Anomia* which might pass for *A. argentaria* of the lower greensand marls of New Jersey, if it were not for the *Modiola;* also a single imperfect internal cast of a small (young?) *Pectunculus*—not enough of it to tell the species—and a small bivalve of which I can not yet determine the genus. * * * These are the only shells I can recognize and from their evidence I should think the rocks could hardly prove to be Cretaceous."

The same specimens were subsequently examined by Mr. A. W. Grabau, of Columbia University, who identified the *Modiola* as *M. sulcata* Lam., a species now living in the Bahama Islands, and also noted a number of specimens of *Leda* sp.?

In addition to the above there are a few coiled shells, one of which is almost certainly referable to *Cerithium* sp.? of Shaler's report (Bull. Mus. Comp. Zoöl., *l. c.*, *pl. 2*, *fig. 12*.)

* Ann. Rept. U. S. Geol. Surv. 7: 341. 1888.
Bull. Mus. Comp. Zoöl. Harvard College, 16: No. 5, 97. 1889.

and the other to *Turritella* sp.? (*l. c. fig.* 7). An ill-defined *Lucina*, which may prove to be Shaler's Fig. 11, and an *Ostrea*, complete the list.

Mr. Grabau is of the opinion that they may represent a new fauna, of more recent age than the Cretaceous, and this is quite consistent with the conditions under which they occur, so far to the south of any recognized Cretaceous outcrop. The character of the matrix also, with a single exception, is notably different from that in which undoubted Cretaceous molluscs have been found elsewhere, being a micaceous sandstone instead of a hardened clay or greensand.

(*b*) *Plant Remains.*

The plant remains are mostly in the hardened clay concretions, but a few are in micaceous sandstone similar to that in which the bulk of the molluscs occur. They include a few good specimens, several of which are well-known Cretaceous species. A complete list and descriptions of all the species collected is appended, together with figures of such as seemed worth depicting.

Although the collection as a whole is meagre it is of importance for the reason that it represents a locality for undoubted Cretaceous fossils at a point further east than that at which such fossils have been previously found, or at least from which they have been previously recorded. The specimens are also unique in their geologic relations, by reason of their occurrence in re-assorted drift material at a considerable distance south of the terminal moraine. They therefore must have been subjected first to erosion and transportation by ice action and subsequently to further transportation by water.

List and Descriptions of Species.

Podozamites sp.? (Plate 41, Figs. 8, 9.)

These specimens are too fragmentary for anything except provisional determination. They might be more or less suc-

cessfully compared with similar fragments described under several different specific names in the genera *Zamites* or *Podozamites* and it may be of interest in this connection to refer to the description and figures of *Zamites globuliferus* Heer, from the Komé beds of Greenland (Fl. Foss. Arct. **6**: Abth. 2, 12, *pl. 4*, *figs. 1a*, *b*, *2a*, *b*, *3–7*), a geological horizon which is lower than that to which we are justified in considering our specimens to belong, although the time interval between them is not sufficient to render identity of species improbable. Several species, such as *Sequoia Reichenbachi* (Gein.) Heer, for example, we know to have a greater vertical range than the above would imply.

DAMMARA BOREALIS Heer. (Plate 41, Fig. 6.)

Fl. Foss. Arct. **6**: Abth. 2, 54, *pl. 37*, *fig. 5*.

Also identified from the Cretaceous of New Jersey (?), Staten Island, Long Island, Block Island (?) and Martha's Vineyard, and apparently identical with the organisms also described by Heer as the fruit of *Eucalyptus*. (Fl. Foss. Arct. **6**: Abth. 2, 93, *pl. 45*, *figs. 4–9*.)

I have questioned the occurrence of this species in New Jersey and on Block Island for the reason that the only specimens figured from those localities are much smaller than represented by Heer and should properly be referred to *D. microlepis* Heer (Fl. Foss. Arct. **6**: Abth, 2, 55, *pl. 40*, *fig. 5*), if this is to be maintained as a distinct species.

CUNNINGHAMITES ELEGANS (Corda) Endl. (Plate 41, Fig. 11.)

Synop. Conif. 270.

Cunninghamia elegans Corda, in Reuss. Verstein. Böhm. Kreidef., Abth. 2, 93, *pl. 49*, *figs. 29–31*.

I was somewhat in doubt whether to consider this specimen as a small one of *Cunninghamites elegans*, such as figured by Newberry from the Cretaceous of New Jersey (Fl. Amboy Clays, Monog. U. S. Geol. Surv. **26**: *pl. 5*, *figs. 6*, *7*), or a large one of *Sequoia Reichenbachi* (Gein.) Heer, for example that figured by Velenovsky from the Cretaceous of

Bohemia (Gymnosp. Böhm. Kreidef., *pl. 9, fig. 12a*). I am of the opinion however that the length of the leaves indicates its identity with the former.

Juniperus hypnoides Heer (?). (Plate 41, Figs. 7, 7a.)

Fl. Foss. Arct. **6**: Abth. 1, 47, *pl. 44, figs. 3, 4; 46, fig. 18.*

Although the leaves in our specimen are apparently more closely appressed and somewhat shorter and broader than in Heer's representation of the species, I am inclined to think that this is due to the fact that only young terminal branchlets are included in ours, and these usually bear leaves markedly different from those of the older or lower parts of the branches.

Reported also from the Cretaceous of Staten Island and Martha's Vineyard.

Thinnfeldia subintegrifolia (Lesq.) Knowlton. (Plate 41, Figs. 13, 14.)

Cat. Cret. & Tert. Plants N. Am., Bull. U. S. Geol. Surv., No. 152, 228. 1898.

Phyllocladus subintegrifolius Lesq., Am. Journ. Sci. **46**: 92. 1868; Cret. Fl., 54, *pl. 1, fig. 12.* 1874.

Thinnfeldia Lesquereuxiana Heer, Fl. Foss. Arct. **6**: Abth. 2, 37, *pl. 44, figs. 9, 10; 46, figs. 1–12b.* 1882.

This is one of the most abundant species in the Cretaceous of New Jersey and it has also been identified from Staten Island, Block Island and Martha's Vineyard.

Thinnfeldia variabilis Vel. ? (Plate 41, Fig. 12.)

Gymnosp. Böhm. Kreidef. 6, *pl. 2, figs. 1–5; 3, fig. 12.* 1885.

Not *Thinnfeldia variabilis* Font., Potomac or Younger Mesozoic Flora, Monog. U. S. Geol. Surv. **15**: 110, *pl. 17, figs. 3–7; 18, figs 1–6.* 1889.

I am in some doubt as to whether our specimen belongs to the species described and figured by Velenovsky from the

Cretaceous of Bohemia. It is too imperfect for accurate comparison and may belong in the genus *Gangamopteris* or one nearly allied. I can not identify it with any species heretofore described from America, as it is clearly different from Fontaine's *Thinnfeldia variabilis*, which name he undoubtedly applied unintentionally to a totally different species than that of Velenovsky, but it is too fragmentary to serve as a basis for the description of a new species.

SCLEROPHYLLINA DICHOTOMA Heer. (?) (Plate 41, Fig. 10.)

Fl. Foss. Arct. **1**: 82, *pl. 44, fig. 6; ibid.*, **3**: (Kreide-Fl.) 59, *pl. 17, figs. 10, 11.*

This single fragment is too imperfect for anything but provisional reference and might perhaps be equally well considered under some other closely allied genus, such as *Jeanpaulia* or *Baiera*, and in this connection it is of interest to recall that Dr. Newberry provisionally referred a somewhat similar fragment from the Amboy clays to *Baiera incurvata* Heer. (Monog. U. S. Geol. Surv. **26**: 60, *pl. 10, fig. 6.*)

The reference to *Sclerophyllina dichotoma* Heer, a species from the Komé beds, may be criticised on the general principle that its presence in connection with undoubted middle Cretaceous species would infer for it a very considerable vertical range, but the same may be said in regard to *Cunninghamites elegans* (Corda) Endl., with which it is associated, in regard to which we are well assured, both as to identity and range.

SALIX MEEKII Newb. (Plate 41, Fig. 1.)

Ann. N. Y. Lyc. Nat. Hist. **9**: p. 19. 1868. Later Ext. Fl. N. Am., Monog. U. S. Geo. Surv. **35**: 58, *pl. 2, fig. 3.*

This is the species referred by Lesquereux to *S. cuneata* Newb., in Illustrations of Cretaceous and Tertiary Plants, *pl. 1, fig. 3.* It is apparently identical with certain forms of *S. proteaefolia* Lesq. (var. *lanceolata* Lesq. Fl. Dak. Group, Monog. U. S. Geol. Surv. **17**: 50, *pl. 64, figs. 6–8*). It

has also been identified from the Cretaceous of New Jersey, Staten Island (?) and Block Island.

MAGNOLIA ALTERNANS Heer. (Plate 41, Figs. 4, 5.)

Phyl. Crét. Nebraska, Nouv. Mém. Soc. Helvet. Sci. Nat. **22**: 20, *pl. 3, figs. 2–4; 4, figs. 1, 2.* 1867.

Also identified from the Cretaceous of New Jersey.

MYRSINE ELONGATA Newb. (Plate 41, Fig. 2.)

Fl. Amboy Clays, Monog. U. S. Geol. Surv. **26**: 122, *pl. 22, figs. 1–3.*

This species has also been found in the Cretaceous of Staten Island and Long Island, as well as in New Jersey.

TRICALYCITES PAPYRACEUS Newb. (Plate 41, Fig. 3.)

Fl. Amboy Clays, Monog. U. S. Geol. Surv. **26**: 132, *pl. 46, figs. 30–38.*

This well-defined little organism is exceedingly abundant in the Cretaceous of New Jersey and has also been identified from Staten Island, Long Island and Block Island.

RHIZOMORPHS.

Many of the concretions contain the characteristic tubes to which I applied the term *Rhizomorphs* in describing similar organisms in Cretaceous clay concretions found on Staten Island. (Ann. N. Y. Acad. Sci. **11**: 423, *pl. 38, fig. 1.* 1898.)

Explanation of Plate.

PLATE 41.

Fig. 1. *Salix Meekii* Newb.
Fig. 2. *Myrsine elongata* Newb.
Fig. 3. *Tricalycites papyraceus* Newb.
Figs. 4 and 5. *Magnolia alternans* Heer.
Fig. 6. *Dammara borealis* Heer.
Figs. 7 and 7a. *Juniperus hypnoides* Heer (?)
Figs. 8 and 9. *Podozamites* sp.?
Fig. 10. *Sclerophyllina dichotoma* Heer (?)
Fig. 11. *Cunninghamites elegans* (Corda) Endl.
Fig. 12. *Thinnfeldia variabilis* Vel.
Figs. 13 and 14. *Thinnfeldia subintegrifolia* (Lesq.) Knowlton.

IV. CONCLUSIONS.

The occurrence of Cretaceous fossils and of contorted or eroded Cretaceous clays, has been satisfactorily recognized, in connection with the terminal moraine, on Staten Island, Long Island, Block Island, the Elizabeth Islands and Martha's Vineyard, but definite evidence is yet lacking of such occurrence at any point further to the east or north. Tertiary and more recent fossils have been found, under similar conditions, but to a more limited extent, on Staten Island, Long Island and Martha's Vineyard and also further to the east on Nantucket and to the north on Cape Cod.

On the mainland of New England no indications of Cretaceous strata have yet been discovered, although the occurrence of plastic clays in the moraine on the island of Naushon, at the mouth of Buzzard's Bay, indicates their former presence in the immediate vicinity, in place.

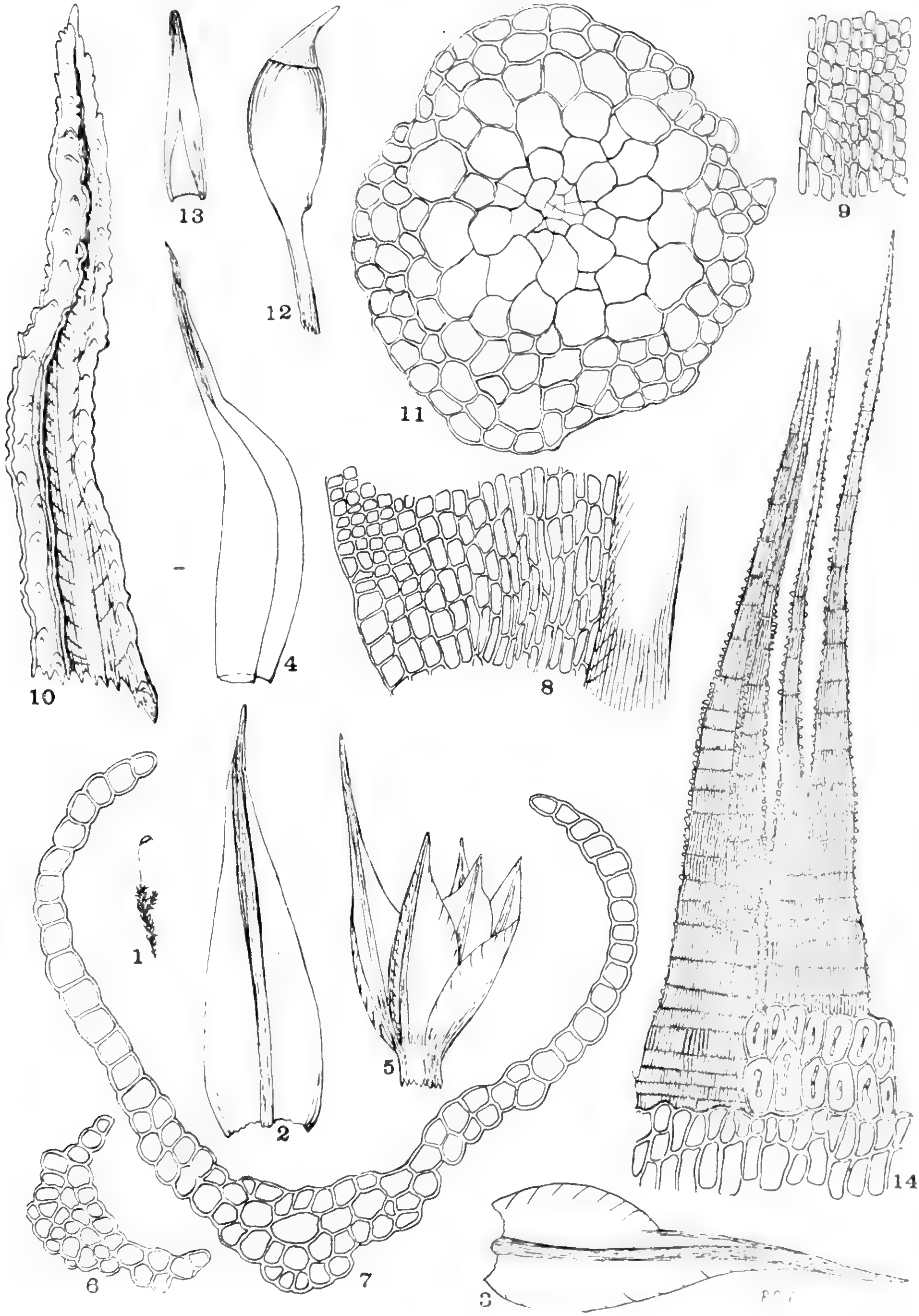
Tertiary strata, in place, are recognized on the mainland of eastern Massachusetts, at Marshfield.

Considering these facts, in connection with the stratigraphic relations of the Cretaceous and Tertiary strata in New Jersey and southward, the indications are that Cretaceous strata formerly outcropped in a belt along the present southern New England coast line as far east as Buzzard's Bay, while south of this belt, and extending northward along the present eastern New England coast line, were strata of Tertiary age. Glaciation during the Quaternary period resulted in the erosion of these strata and the incorporation of their remnants in the terminal moraine, leaving troughs throughout the region formerly occupied by them, which are now filled with salt water.

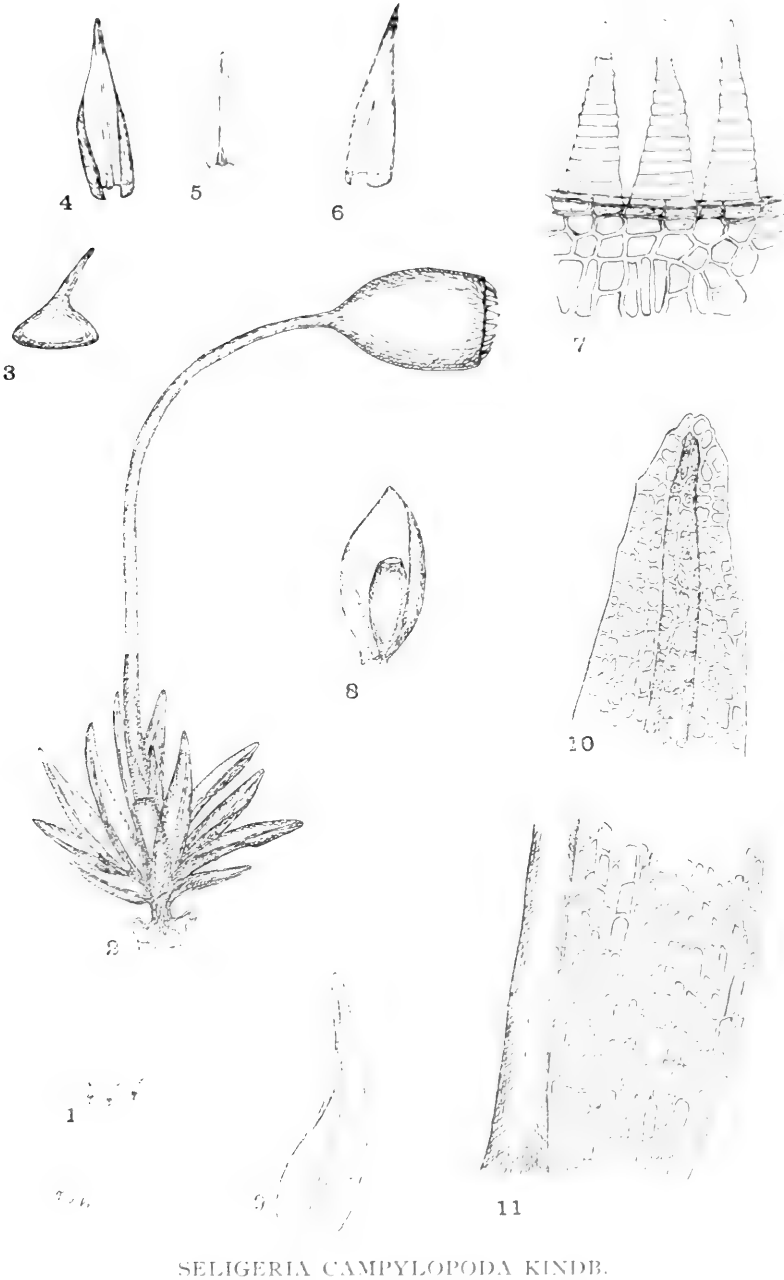
If the above facts and indications have been correctly interpreted, we may therefore assume that the direction of glacial movement along the southern shore was towards the southeast, approximately in the direction of an imaginary line drawn from the eastern shores of Buzzard's Bay to the eastern extremity of Martha's Vineyard; these localities representing

respectively the theoretical eastern limits of Cretaceous strata in place and the same as morainal material.

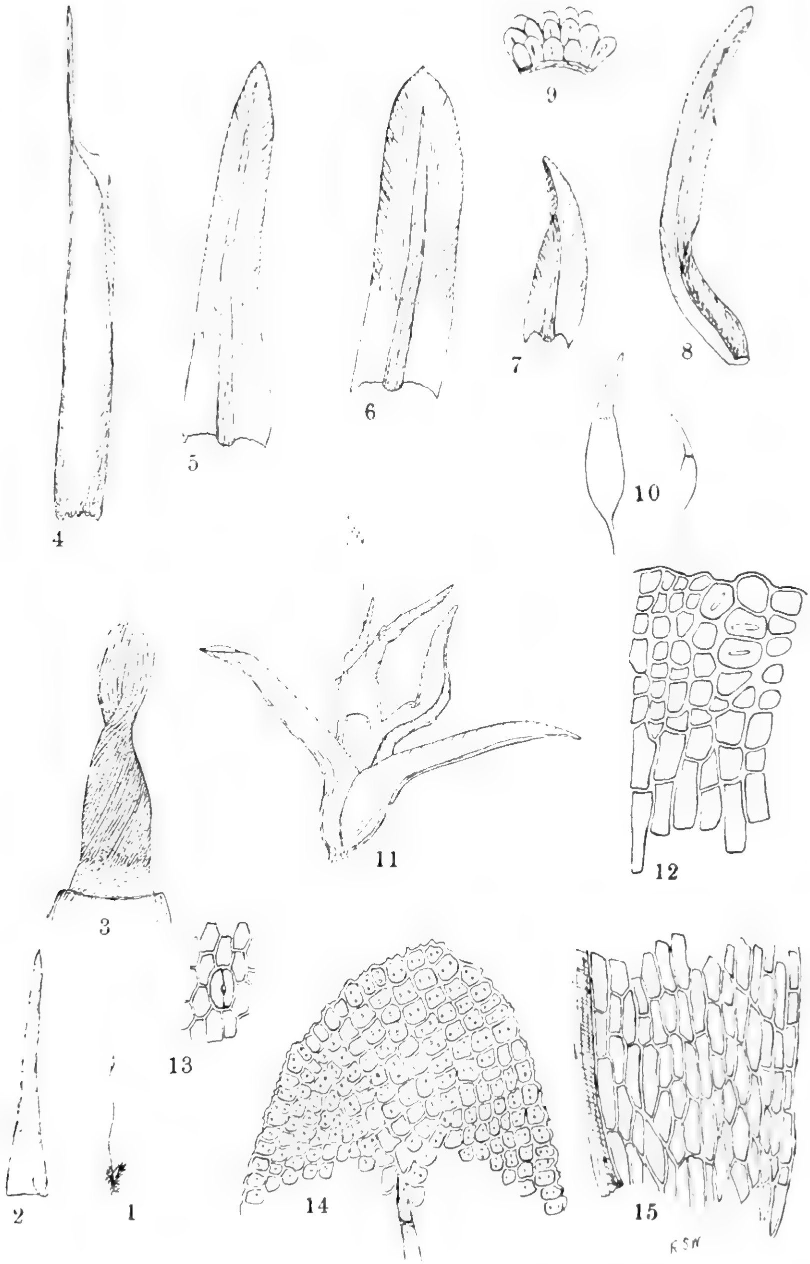
The same general direction of movement, somewhat further to the east, could have resulted in the transportation of Tertiary material from the Marshfield locality to Nantucket, but a change to an easterly movement would have to be assumed if the Tertiary fossils in the moraine at Truro are to be referred to the same general locality for their origin, and such a change is clearly shown by the glacial striæ on the rocks of the mainland. The ice evidently spread out like a fan, flowing southward towards the southern coast and eastward towards the eastern coast, with the farthest marginal extension towards the southeast, in the form of a great lobe, of which the island of Nantucket is the remnant. Nor is it necessary to assume any abrupt change in the direction of movement in order to account for the Tertiary fossils at Truro, as it is a perfectly reasonable assumption that their original home may have been in strata which once extended further north than the locality at Marshfield.



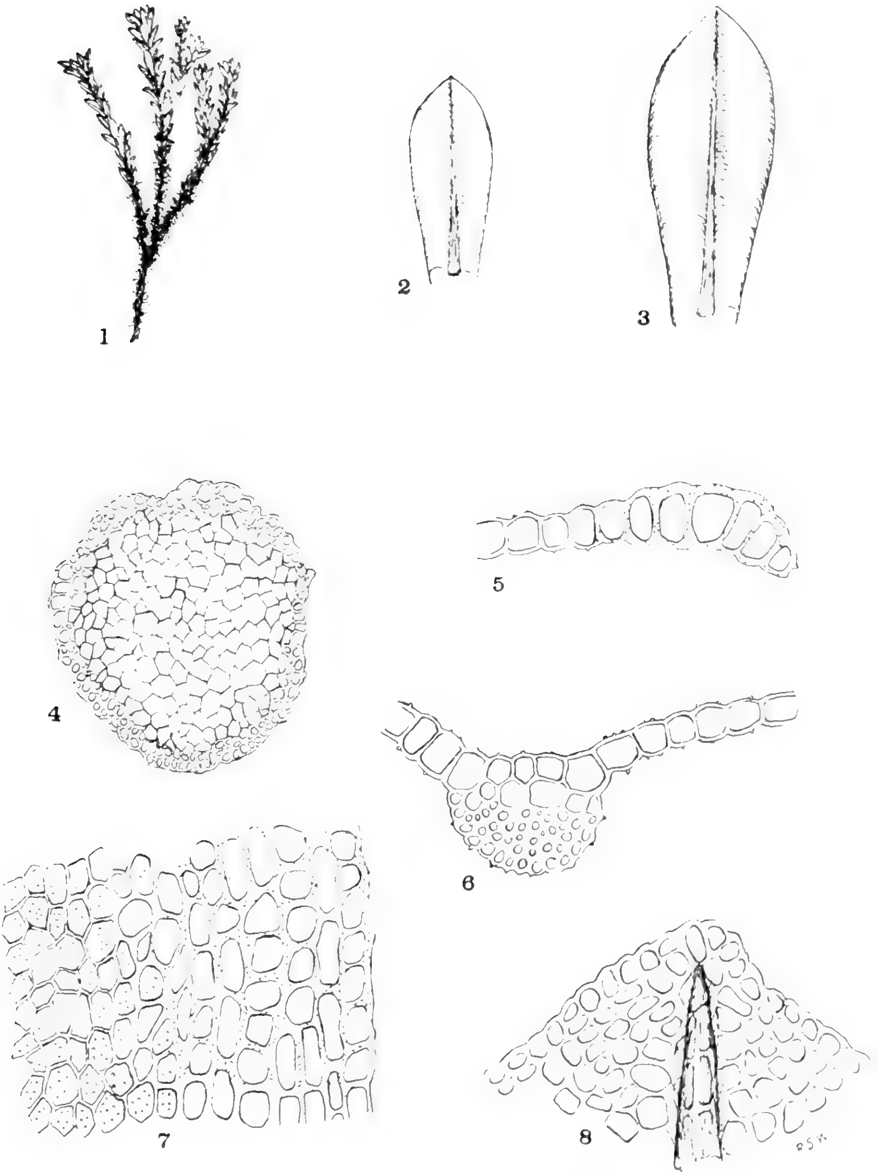
DICRANUM HISPIDULUM R. S. WILLIAMS.



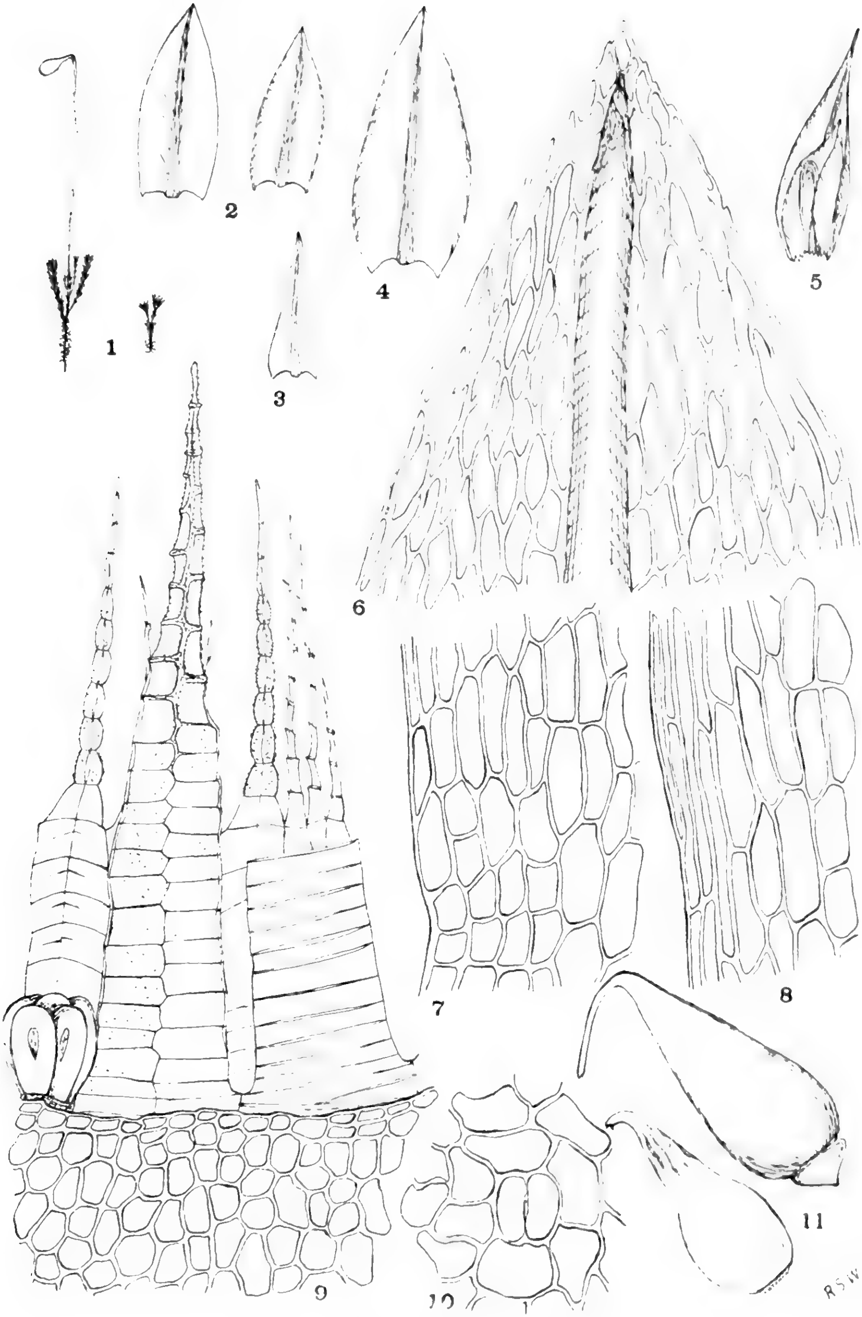
SELIGERIA CAMPYLOPODA KINDB.



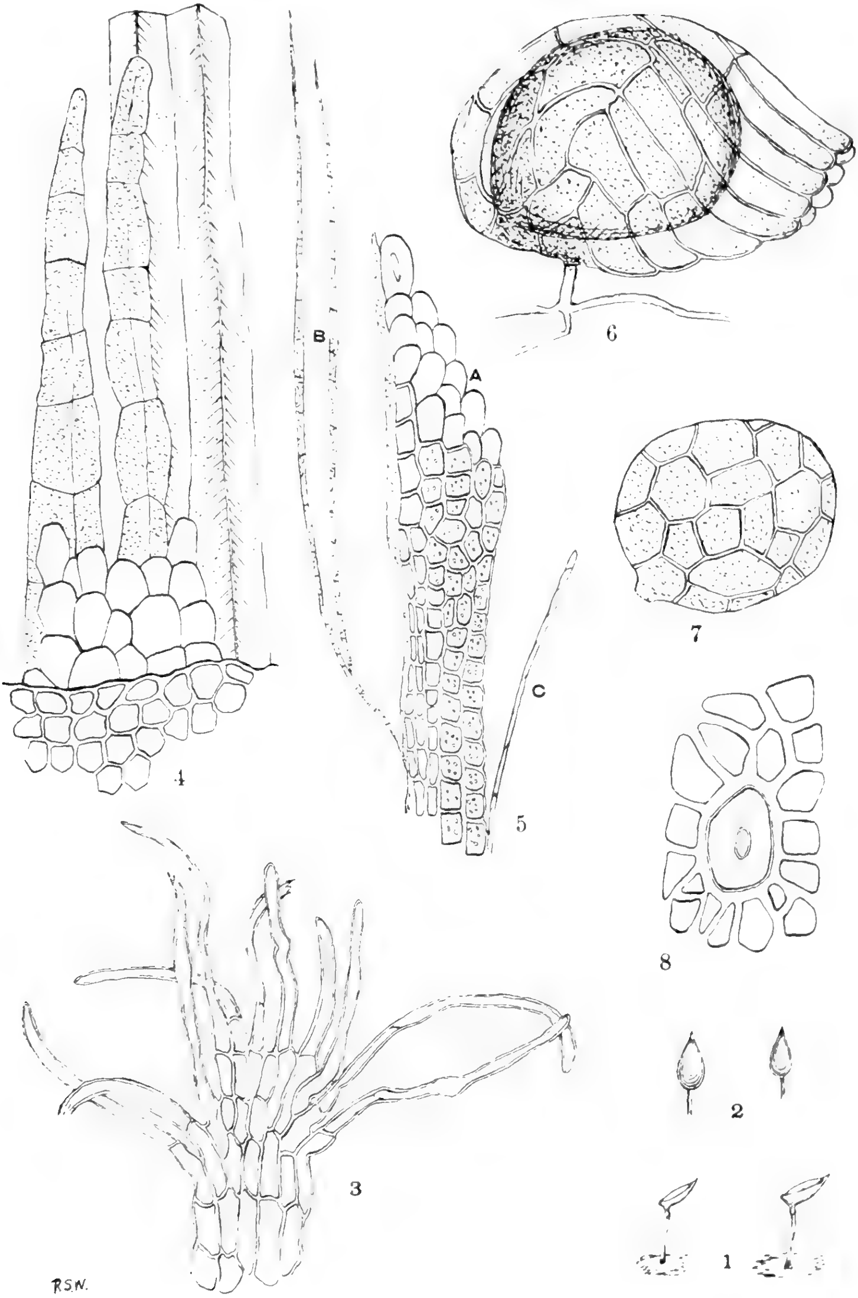
BARBULA PERANNULATA R. S. WILLIAMS.



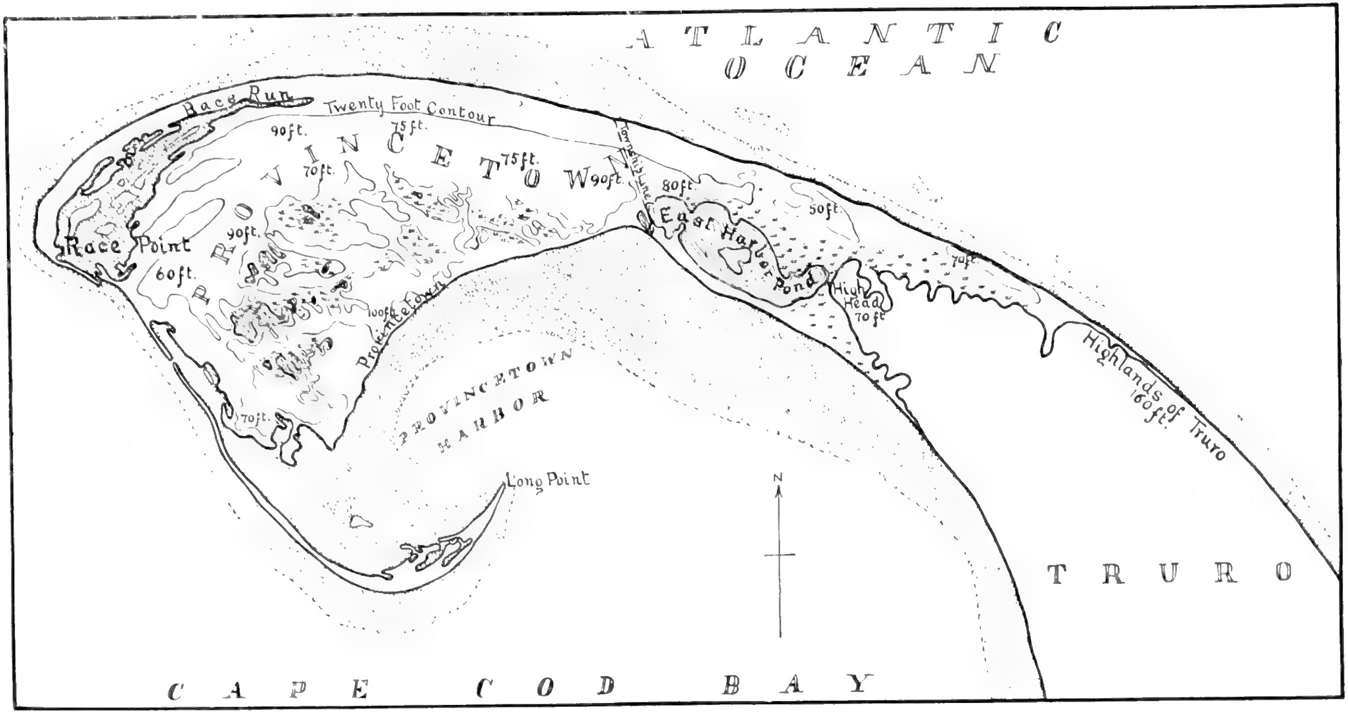
MERCEYA LATIFOLIA KINDB.



BRYUM WILLIAMSI PHILIBERT.

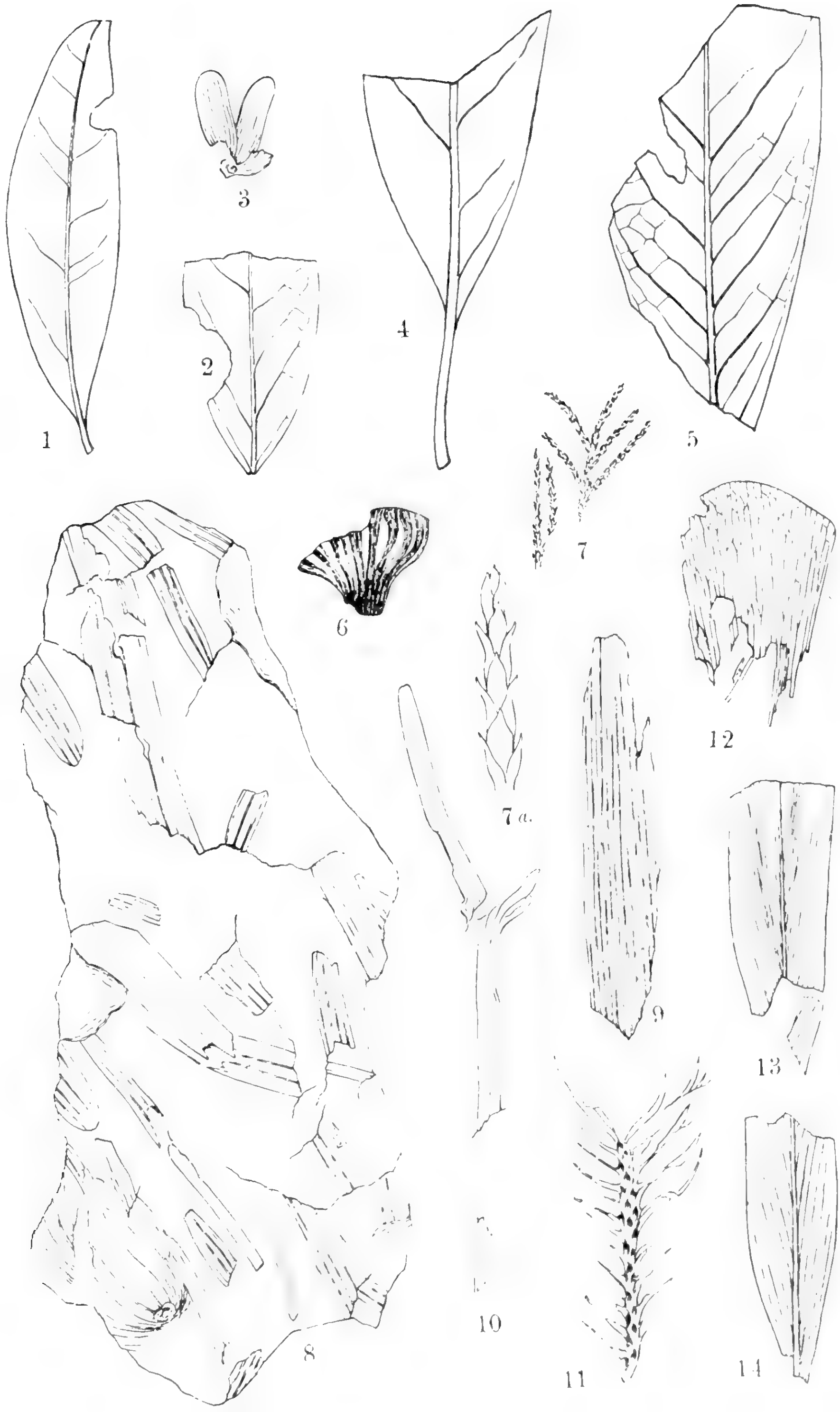


BUXBAUMIA PIPERI BERT.



MAP OF PROVINCETOWN, CAPE COD, MASS.

SHOWING PRINCIPAL ELEVATIONS AND SURROUNDING SHOALS.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Members of the Corporation.

VOL. 2. NO. 8.

BULLETIN

OF

THE NEW YORK BOTANICAL GARDEN.

[ISSUED MARCH 18, 1903.]

CONTENTS:

BULLETIN

OF

The New York Botanical Garden

Vol. 2. No. 8.

REPORT OF THE SECRETARY AND DIRECTOR-IN-CHIEF FOR THE YEAR 1902.

(*Accepted and ordered printed January 12, 1903.*)

To the Board of Managers of the New York Botanical Garden.

Gentlemen: I have the honor to submit herewith my report as Secretary and Director-in-Chief for the year ending January 12, 1903.

The work of the past year has been mainly directed toward the maintenance and development of the features previously installed, and to the carrying out of plans previously adopted. A large amount of construction has been accomplished, the collections in all departments have increased materially, both in size and in value, the number of visitors has exceeded vastly that of any previous year and more students are enrolled at present than ever before. The Endowment Fund has been increased by about $20,000, and the number of annual members and life members now stands at 1,049, an increase during the year of 91.

Plants and Planting.

1. *Herbaceous Grounds.* Contingent upon the increasing size of the collections, considerable land has been taken into cultivation in the herbaceous grounds, especially in the plantations illustrating the rose family, the mint family and

the thistle family. Considerable rearrangement of the species in other beds has been made. The small lake at the southern end of this tract, excavation for which was commenced during the fall of 1901, was completed in the spring, and its surroundings restored to lawn, thus adding a valuable landscape feature to this part of the grounds. The outlet of the watercourse, of which this lake forms a part, has been through a rough stone drain running south from a point on our southern boundary, several hundred feet through land of Bronx Park toward the Bronx River, the water there being discharged into a natural valley, forming a brook; this drain has always given some trouble, not being of sufficient capacity to take the water off rapidly enough, and it also, at times, became partially choked by leaves; the amount of water flowing into the valley of the herbaceous grounds during heavy storms has been increased by the drainage from new roads and paths. The trouble culminated during the early part of this winter by the backing up of the water into the herbaceous garden, making it necessary to open this old drain for several hundred feet, and replace it by a large earthenware pipe, laid to a proper grade; this work is now in progress and will no doubt relieve the condition.

The bringing of species hitherto unrepresented in the herbaceous grounds from the nurseries, and from other sources, has been continued, and the number of species grown in these plantations during the year is some 3,000; about the same as last year, some having failed to survive the winter, or died from other causes.

2. *Fruticetum.* Contingent upon road- and path-building operations, commenced during the year on the plain north of the Museum Building, the rearrangement of the shrub plantations planned for last spring was deferred until the necessary grading operations should be more nearly completed. This work was far enough advanced in the southeastern part of the fruticetum this autumn to enable us to replant it in approximately permanent form, and this work may go forward to advantage in the spring of 1903. The number of species

of shrubs in this collection is now 530. It will probably be practicable to materially increase this representation of species during the next year, for it seems probable that the roads and paths in that part of the Garden will be essentially completed during 1903.

3. *Salicetum.* The collection of willows and poplars, planted in the meadows and marshes at the northern end of the Garden has been cultivated roughly, and the number of species increased from 43 to 50.

Here, again, it has not been practicable to plant much land permanently, on account of road and path-building, but this work will probably be largely completed in that area during the next year.

4. *Arboretum.* Little addition has been made to the tree collections, on account of the necessity of concentrating work on other departments. The trees already planted have been cared for and a considerable number of additional ones have been set in place, as rapidly as grading operations permitted. Considerable portions of the area about the public conservatories, and between them and the Museum Building, set aside for the main collection of coniferous trees, have been prepared for them, and much of it can be planted in the spring, the young trees being derived from our nurseries, and from those of Mr. Lowell M. Palmer, at Stamford, Connecticut, whose valuable gift of these plants has already been reported. The total number of species of hardy trees represented in the Garden, including the native kinds, is now about 300, some of which are still in the nurseries.

5. *Viticetum.* The rough arbor built on the border of the forest east of the Museum Building, for the purpose of training vines, has served its purpose very well, some of the species now having covered considerable parts of it. This collection is at present somewhat inaccessible, but the carrying out of plans for path-building during the next year, will bring it within an easy walk of the Museum Building and the herbaceous grounds. The number of species of vines and trailers grown there during the year is about 60.

6. *The Public Conservatory Collection.* A great development has been made in the collections of plants cultivated under glass during the year, both in the increase in the number of species, derived from various sources, and in the growth of specimens previously installed. The completion of the range of greenhouses, made in the year, greatly facilitates the cultivation and care of the plants by providing seven compartments additional to those first constructed, and the large additional cellar-space obtained at the same time made maintenance operations much simpler and more convenient. The number of species grown in the public conservatories is about 5,800, as against 3,400 a year ago. The additions have been obtained wholly by exchange with other institutions, by collection in various parts of tropical America, and by growth from seeds in our propagating houses.

Contributions of money for obtaining plants were received as follows:

Tiffany and Company	$250.00
C. T. Cook	25.00
Fritz Achelis	98.55
Paul N. Spofford	3.00
	$376.55

This sum has been expended principally in paying transportation charges from other institutions and from tropical America.

In the late spring Mr. George V. Nash, head gardener, was sent to Europe for the purpose of arranging additional exchanges with botanical gardens; his errand was very successful, and the immediate results have been duly reported in our Journal. Since his return a considerable number of specimens have been received from institutions visited by him.

The inadequacy of the present buildings for the proper display of the rapidly increasing collections is becoming apparent already, and the experience of European institutions shows that we should begin to plan for additional houses, in order that they may be obtained before damage is done by

crowding the collections already brought together. The present houses supply an abundance of head-room for plants, even for the tallest that we shall be able to grow, for many years, but the floor- and bench-areas will soon become insufficient. I propose to ask your permission, at an early date, to commence the study of plans for another large range of houses, which, probably, on account of the much less height required, should cost very much less than the present structures. If this permission be granted, it will enable us to incorporate in the new plans numerous specially constructed compartments for the cultivation of certain groups of plants which cannot be made to grow well in large rooms, but which nevertheless are of great general interest and high scientific importance.

7. *Nurseries.* The area devoted to nurseries and propagating greenhouses on the east side of the Garden, south of the stable, has not been increased during the year, the land already under cultivation being found sufficient for present purposes. A very large number of plants have been moved from the Nurseries into the permanent out-of-door plantations, and from the propagating houses to the public conservatories. Necessity has been demonstrated for the completion of the range of propagating houses, and it is hoped that arrangements for the building of the low glass house needed to accomplish this may be made during the year.

8. *Boundary Borders.* The planted borders have been cultivated, and considerably thinned, many shrubs and trees having been moved from them into other positions. The "Old-fashioned Flower Garden," planted in front of the boundary screen along the railroad, from the Southern Boulevard approach north to the lakes, has been almost wholly replanted and rearranged, and at the same time considerably widened. The border along the St. John's College property line has been roughly cultivated, and, contingent upon the building of the approach to the Manhattan Railway Station, at the southwestern corner of the Garden, has been entirely replanted at that point. Little work has been done on the

north and east borders, except in the neighborhood of the stable; these borders cannot be put into permanent shape, except at rather widely separated intervals, until the streets planned to bound the Garden along those sides are constructed; and there seems no present indication of this being taken up by the City.

9. *Other Plantations.* The trees and shrubs formerly planted in the vicinity of the Harlem Division railway station have been kept cultivated, and the plantations somewhat increased; the completion of the driveway and path approach to the Southern Boulevard bridge, over this railroad, enabled us to accomplish considerable planting there during the autumn, and other plantations were set out near the approach to the Elevated Railway.

The total number of species now represented in the plantations and conservatories, including the native flora of the tract, is about 10,600 as against about 9,300 a year ago, an increase during the year of about 1,300.

The general direction of all gardening operations and of the labeling and recording of the plants has been carried out by Mr. George V. Nash, head gardener, and Mr. George A. Skene, second gardener; the immediate direction of the work in the public conservatories has been in charge of Mr. James Skinner, foreman gardener, for the portion of the range west of the central dome, and of Mr. Adam Muller, foreman gardener, for the central dome and the houses east of it. Further details relative to plants and gardening will be found in the report of the head gardener, hereto appended.

Buildings.

1. *Museum.* The maintenance of the museum building has been confined to ordinary repairs carried out by our own employees, including painting, replastering and repainting; it has been sought to make repairs as soon as they become necessary, rather than to allow any considerable amount of such work to accumulate. Funds at our command were not sufficient to accomplish all that was desirable, but it is planned to do everything necessary within the next few months.

Additional construction-work includes the completion of the ornamental terra-cotta work on the roof, included in the contract of the Department of Parks with the Wilson & Baillie Manufacturing Company; the construction of a large quantity of shelving for the convenient arrangement of the publications of the Garden, constantly needed for exchanges; the building of six additional herbarium cases of the ordinary design, and of two combination book-shelf and herbarium cases at the north end of the main herbarium room; the shelving of the walls of the library reading room; the building of two specially constructed tables for use in the laboratory, and of a card-catalogue case for the library.

The need of a large amount of additional furniture for all parts of the museum building became evident during the summer, owing to the rapidly increasing size of the collections in all departments, and in October a contract was awarded to Thomas Dwyer, by the Commissioners of Public Parks, for the building and placing in position of cases of a number of different patterns, the amount of this contract being $32,590, this expenditure having been authorized by the Board of Estimate and Apportionment in voting an appropriation of $150,000 during the summer for additional construction-work of all kinds. This furniture was all designed by Mr. R. W. Gibson, architect, and his plans and specifications were duly approved by you, and by the Commissioner of Public Parks. Some of this furniture has been received already, and it is expected, under the terms of the contract, that it will all be in place by the spring. This additional equipment should supply our needs for furniture for at least two years, in so far as the growth of the collections can be foreseen.

Front Approach to the Museum Building. As recorded in my last annual report, the contract awarded early in 1901 to the Wilson & Baillie Manufacturing Co. included the construction of driveway and path approaches to the museum building, together with certain architectural works, including fountains and stone seats, and it was there stated that the work

had been unreasonably delayed in completion; this delay continued nearly until the end of 1902, though it was so far finished during the autumn as to make it possible for us essentially to complete the grading work contingent upon it, during the latter part of the year. Certain details of the contract have not yet been actually adjusted between the contractor and the Department of Parks. There is a time-penalty in this contract, the operation of which should cause the contractors to pay heavily for their delay. The work, as finally delivered by the contractors, is satisfactory, except in some insignificant details.

The subcommittee of the Executive Committee, charged with the obtaining of a model for the statuary fountain to be erected in front of the museum building, the basins, water supply, foundations and drainage for this fountain having been constructed under the contract above referred to, received in the spring a model from Mr. H. A. MacNeil, sculptor; this was carefully examined by the subcommittee, but was not accepted. The subcommittee then decided to request the National Sculpture Society to organize a competition of sculptors, and to select from models submitted, under the terms of this competition, the one best suited, in their judgment; the subcommittee agreeing to recommend the adoption of the model so selected by the National Sculpture Society. After a large amount of correspondence, and of consultation with officers and committees of the Sculpture Society, a programme and rules for such competition have been arranged, and it is hoped that models may be submitted, and a suitable one selected, within a few weeks.

2. *The Public Conservatories.* The houses needed to complete the range of public conservatories, construction of which was commenced in May, 1901, under the contract of the Department of Parks with John R. Sheehan & Co., were accepted from the contractors early in the year, and were at once put into operation. Minor defects in drainage and leakage, which were developed, were made good by the contractors.

Maintenance of these conservatories has included only ordinary painting, the placing of some internal shades, and ordinary repairs to the great area of glass. The whole range must be painted during the coming summer in order to keep it in good repair. No difficulty has been found in operating the heating system, except in one of the newer houses, where it may prove necessary to add a little more radiating surface in the future.

Additional slate benches were placed in house No. 6, given over to cactuses, and in house No. 9, containing the tree-ferns. Shelving for the convenient storing of flower-pots and other supplies, and additional benches for potting work, were built in the cellar.

3. *Power House and Subways.* The difficulty experienced immediately after the building of the power house and the subways carrying the steam pipes from it to the museum building and the public conservatories, of surface water getting access to the subways and flowing into the power house, has been practically obviated, by grading operations, and the restoring of excavated areas to lawn; it is believed that this danger has now been removed.

At the close of the firing period, in the spring, a careful examination of the whole heating plant was made, in consultation with Mr. Gibson, the architect, and it was found necessary to rebuild portions of the brick walls supporting the boilers, and to reline the furnaces; this work was done by contract, under specifications prepared by Mr. Gibson, and the work supervised by him. At the same time the grates ordinarily used for the furnaces were found to have been considerably damaged by wear, and a new set of grates of a more recent pattern was put in; these have proved more economical and easier to operate than the old ones.

Leakage of steam, referable to a defective pipe in the subway between the power house and the museum building, was discovered early in the autumn, and repaired.

A portion of the cornice on the roof of the power house which had been damaged in the dumping of coal, was rebuilt.

Beyond this work, the steam heating plant has required only ordinary maintenance, and it is believed to be in capital condition at the present time.

4. *Propagating Houses.* These small greenhouses have required only ordinary repairs.

5. *Stable.* Only minor repairs have been necessary including painting and the reflooring of stalls.

6. *Public Comfort Station.* This building, erected three years ago, has not yet been opened the public, although it is ready for operation at such a time as the road and path system in its vicinity shall be constructed. It is meanwhile serving a very useful purpose for storage.

7. *Tool House.* No changes have been made at this building.

8. *Approach to the Bronx Park Station of the Manhattan Railway Company.* Early in the year, the Manhattan Railway Company made arrangements to extend its elevated structure from Fordham, north to the southwestern corner of the Garden, and requested that arrangements be made for the establishment of an entrance to the Garden for their passengers at that point. This was unexpected, and required a very careful consideration of plans, and of an agreement with the Manhattan Railway Company. After a thorough study of the subject, an agreement, plans, and specifications for the construction of such an approach were adopted by you and by the railway company. The plans and specifications were prepared by Mr. John R. Brinley, landscape engineer, and by Mr. R. W. Gibson, architect, and were duly approved by the Commissioner of Parks for the Borough of the Bronx. The agreement provides that the Manhattan Railway Company shall pay the New York Botanical Garden the entire cost of erecting the approach, and for its proper maintenance, the Board of Managers of the Garden retaining the right to close this entrance at times when the Garden is not open to the public, and to cause the removal of the approach in case it should become dangerous, or for other sufficient reasons. Construction was begun on this

work early in the spring, and it was completed in December; payment has been made by the Manhattan Company for the entire cost of construction; the approach was put in use immediately upon its completion.

Permission was given the Manhattan Company to use a temporary entrance to the Garden, over a temporary wooden incline, erected on the grounds of St. John's College, during the period of construction of the approach; this temporary entrance has now been closed and the temporary wooden structure removed.

Drainage and Sewerage.

The sewer-connection in the Southern Boulevard from the approach over the New York Central and Hudson River Railroad to the main sewer in Webster Avenue, to serve as an outlet for all the drainage and sewerage of the southwestern part of the Garden, was completed early in the spring. Pressure of other work prevented the connection from being made on the Garden side of the railroad, and this work has recently been taken up; it will probably take about two months to finish it. We shall then have all the heavy work of the drainage and sewerage completed, and it is a great satisfaction to realize that no apprehension need be felt concerning this part of the work of construction.

The work of under-draining the north meadows at the northern end of the Park, outflowing into the Bronx River, was commenced in the autumn, and essentially completed for the portion of the meadows lying west of the river; the area east of the river will be drained the first thing next spring.

It has been found necessary to construct some four additional surface-basins, with discharge-pipes leading into the main drainage-pipes, in the region about the public conservatories, two along the driveway between the museum building and the herbaceous ground and one near the driveway in front of the museum building.

I have already alluded to the necessity for increasing the capacity of the drainage-system at the south end of the herbaceous ground, and after consultation with the chief engi-

neer of the Department of Parks, am able to report that this work will be taken up at the first opportunity.

In order to effect satisfactory drainage of the swamps and borders of the river in the northern part of the Garden, the dam in the river at the Lorillard Mansion was lowered about 16 inches during the summer, and at the same time rebuilt, furnishing a cascade instead of a water-fall. The effect on the northern part of the grounds was immediately apparent, large areas which have always been saturated being now dry, except during periods of freshet; this work was accomplished in accordance with the general plan adopted when work was first begun.

Water Supply.

It has not been practicable, nor convenient, during the year to extend the water-supply system of the Garden, but grading and road-building in the northern part of the grounds will be far enough completed during the next season, to permit the laying of water-pipes over a large area. In the building of the new driveway, north of the museum building, several hundred feet of 1-inch distribution-pipe was laid under the roadway, in order to avoid tearing up the road-surface in the future.

The building of the 4-foot water-main through the grounds by the City Department of Water Supply, referred to in my last annual report, was entirely completed during the summer.

Grading.

The completion of the contract of the Park Department with John B. Devlin, for roads, paths and grading about the public conservatories, was essentially accomplished in the autumn, there remaining the proper surfacing of parts of the roads and paths, and the building of cut-stone piers at the Southern Boulevard entrances to be completed before work can be accepted. This contract is also months overdue, and contains a time-penalty contract. The grading still remaining to be done around the public conservatories, in addition to that accomplished under the Devlin contract, is going for-

ward as rapidly as weather conditions will allow, and probably can be completed by midsummer.

The grading in front of the museum building carried out under the provisions of the contract of the Park Department with the Wilson & Baillie Manufacturing Company, was completed under the terms of the contract, during the summer; the additional work needed here, including regulating and topsoiling the new surfaces, was at once taken up and completed, with the exception of topsoiling a small area in front of the east pavilion of the museum; it is planned to finish this and to bring the entire front surroundings of the building into lawn, early in the spring.

An area of about an acre south of the driveway in front of the museum building was regulated, graded, topsoiled and sown, during the autumn.

The area west and northwest of the public conservatories, comprising about six acres, was regulated, graded, topsoiled and sown, during the season.

Numerous small areas adjoining driveways and paths, at points where the work could be economically carried on, were also completed.

It now seems probable that all the remaining space denuded in construction operations, between the museum building, the herbaceous garden, and the approach to the Elevated Railroad station, can be brought to approximately finished surfaces and most of it restored to lawn during 1903.

Grading operations contingent upon the building of driveways and paths north and northeast of the museum building, in the northern part of the Garden, were commenced during the summer and have been continually prosecuted. A large amount of earth for filling the marshy areas was obtained from J. P. McDonald, being dumped by him from his temporary railway which crosses the Garden at a point convenient for distribution. The surplus stone from excavations in front of the museum building has been broken into proper size for the Telford foundation of roads and paths, and is being hauled to the northern part of the grounds. This

work has gone on actively during the winter. The surplus stone from excavations about the public conservatories will also be broken up during the winter and hauled to this part of the grounds. The amount of surplus stone obtained in this way will be sufficient to build nearly all the roads and paths planned for the region north of the museum. It was found practicable during the fall to haul stone in one direction and bring topsoil in the other, by the same teams, thus reducing the cost of moving material to a minimum, and similar conditions can be taken advantage of for a time during the next spring.

Grading was also commenced immediately behind the museum building for the purpose of improving that area, the earth being used for filling and the stone for paths. This work will also improve the surface drainage of the land immediately behind the museum building by causing the rain water to flow off rapidly instead of soaking into the ground and giving us trouble in the basement after heavy storms.

Roads and Paths.

The contract of the Park Department with John B. Devlin, awarded December 11, 1900, and described in my last annual report, providing for the building of driveways and paths around the public conservatories, is not yet quite completed; there still remains considerable final surfacing on portions of both the roads and the paths. The time-allowance for this contract has long since expired, and there is no reason why the time-penalty should not be enforced. With the exception of the surfacing work mentioned, it is essentially finished, and should be made good early in the spring.

The new driveway extending from a point between the museum building and the herbaceous grounds, east and south through the woods to the south line of the Garden reservation, was completed during the autumn, and work in continuing it from this point south to Pelham Avenue, where it ends opposite one of the entrances to the Zoölogical Park, was commenced by the Park Department in the autumn and will

doubtless be completed early in the spring; delay in securing trap rock prevented the Commissioner of Parks from finishing it this year.

The paths on the terrace of the public conservatories, which were not included in the contract with John B. Devlin, have been completed during the year; it now remains to connect these with the paths and road approaches, built under the Devlin contract, by stone steps, as provided in plans already approved; meanwhile, temporary wooden steps are provided.

The approach to the Manhattan Railway Station was connected with a path leading to the public conservatories, and with other paths leading to all parts of the Garden.

The Telford foundations of paths around the herbaceous garden, from the herbaceous garden to the museum building, from the Southern Boulevard bridge over the railway to the museum building, and other portions of the path system, laid up last year, have been in great part surfaced with trap rock screenings, and this work has gone forward at every available opportunity, so that by the opening of spring it is believed that all the Telford path foundations, previously laid, will be finally surfaced, sufficient screenings for all this work having been purchased during the fall and stacked at convenient points.

The Telford foundation of the path along the south side of the upper lake northeast of the museum building has been laid up, and will be surfaced at the same time.

The Telford foundation of the main back driveway, extending north from the lakes to the northern end of the Garden, has been laid up for about 900 feet, and the commencement has been made in laying the Telford foundation of paths on the fruticetum.

Further details concerning the construction-work will be found in the report of the Superintendent of Buildings and Grounds, hereto appended. In the progress of the work I have had the advantage of hearty coöperation of the Hon. John E. Eustis, Commissioner of Parks, and of his Engineer-in-Chief, Mr. Martin Schenck; the advice and suggestion of

these gentlemen have been of great value, and I take pleasure in expressing my high appreciation of their interest in the development of the Garden.

Care of the Grounds.

The cleaning, watering and general maintenance of the paths and roads already built has been done by employees of the Park Department.

The drainage-basins have been inspected at intervals, and cleaned out whenever necessary.

The lawns and banks have been mowed and rolled by horses and hand-mowers.

The hay on all undeveloped parts of the tract has been cut and stacked in barracks near the stable, more than enough being obtained for the use of the Garden horses; the surplus has been sold.

The woodlands have been carefully guarded against fires; dead, diseased or unsightly trees have been removed, and dead branches pruned from trees desired for preservation.

On Sundays and holidays the regular police patrol has been supplemented by guards selected from our own employees. Notwithstanding the largely increased number of visitors, no serious damage has been done to the collections; the picking of wild plants, and of branches from flowering shrubs or trees, has been very materially reduced. It was found desirable during the summer to appoint six of our employees special patrolmen, but it has not been found necessary for them to make an arrest; two or three arrests for breaking branches have been made by the city police, and the prisoners fined.

There has been some reduction in the amount of paper and other rubbish scattered by visitors, but it has still been found necessary to detail a boy or a man during the summer and autumn, to pick up and burn such litter. It is apparently possible to obtain convictions in the city courts for leaving rubbish of any kind within the city parks, but it has not yet been attempted to obtain them.

Library.

The report of the Librarian, hereto appended, shows an increase during the year of 1,962 bound volumes, the collection now containing about 13,000 bound volumes. Gifts of books have been numerous, 263 volumes being thus obtained from a number of different contributors, records of which have been duly published in the JOURNAL. Gifts of money used for the purchase of books and credited to the Special Book Fund have been made as follows:

D. O. Mills	$ 500.00
J. P. Morgan	500.00
James B. Ford	250.00
Geo. W. Perkins	200.00
James J. Goodwin	100.00
H. L. Terrell	100.00
W. L. Conyngham	100.00
Lowell M. Palmer	100.00
G. B. Hopkins	50.00
Bernard G. Amend	25.00
O. H. Kahn	25.00
W. H. Parsons	25.00
S. S. Palmer	25.00
Miss Eva V. C. Morris	25.00
Dr. W. Gilman Thompson	25.00
John W. Castree	25.00
Mrs. Wm. M. Kingsland	25.00
Chas. A. Moore, Jr	25.00
Mrs. H. Walter Webb	25.00
Samuel N. Hoyt	25.00
Samuel P. Avery, Jr	10.00
E. S. Ullman	10.00
Chas. Batchelor	10.00
Mrs. Edwin Parsons	10.00
Mrs. Henry Dormitzer	10.00
J. O. Bloss	10.00
Gustav Baumann	10.00
Hon. H. W. Bookstaver	10.00
G. Ramsperger	5.00
Z. E. Newell	5.00
	$2,265.00

Through additional exchanges with other institutions, arranged during the year, the number of journals, periodicals, and reports now received by us for sending our own publications, is 257 as against 207 during 1901.

The rapid growth of the Library has filled nearly all the shelves available, but under the provisions of the new furniture contract, shelving for about one fourth more volumes will be obtained within a few weeks.

Museum and Herbarium.

As shown by the report of the Curator, hereto appended, it appears that about 67,000 specimens have been received for the museums and herbarium, and that about 90,000 specimens have been incorporated into the several permanent collections; thus at least 23,000 specimens previously received, have been brought into use for study. Labeling for the public collections has gone forward continually, and is at present in a satisfactory state of advancement.

Gifts of money for the purchase of collections, credited to Museum and Herbarium Fund, have been made as follows:

George Foster Peabody	$100.00
H. C. von Post	100.00
James J. Higginson	100.00
F. N. Warburg	100.00
Robert W. de Forest	50.00
T. G. Sellew	25.00
H. P. Frothingham	25.00
D. Stuart Dodge	25.00
Jno. H. Bloodgood	25.00
E. W. Fitch	25.00
J. P. Cranford	10.00
Edward N. Tailer	10.00
Hon. W. Bourke Cockran	10.00
Mrs. A. D. Russell	10.00
Pauline Boettger	10.00
Edwin O. Meyer	10.00
Miss Mary Taber	5.00
E. E. Olcott	5.00

Miss J. R. Cathcart	5.00
Theo. L. De Vinne	5.00
	$655.00

The new cases now being built will enable us to install nearly twice as many specimens as have hitherto been mounted for examination; this additional display will very greatly increase the educational value of the collections.

Accessions of specimens have been duly reported in the JOURNAL as received, and the detail work of this department is given in the report of the Curator.

Laboratories.

Applications for use of tables in the laboratories have been more numerous than ever before, and have taxed their capacity. The new tables now being built will enable us to accommodate some additional students. As appears from the report of the Director of the Laboratories, hereto appended, forty-three students, including graduates of thirty-one different colleges and universities, have been granted the privileges of the laboratories, library and herbarium, during this year, and these students have pursued investigations in practically all lines of botanical research.

The facilities of the laboratories have also been accorded to numerous visiting investigators from other institutions. Several of the students are occupying teaching positions, while a number have passed from the Garden into teaching and research positions in schools and colleges.

Dr. Wm. Austin Cannon has assisted Dr. MacDougal in the laboratory work during the latter part of the year.

Lectures.

Spring and autumn courses of public lectures have been delivered on Saturday afternoon as in former years, in the Lecture Hall of the Museum Building. The spring course commenced on April 18 and closed on June 14; the autumn course began on October 4 and closed on November 8. A number of these lectures have since been published in the

Garden JOURNAL and other periodicals. Cards for these two lecture-courses were sent to all members of the Garden, notifying them also that they would be received by members of the staff on the afternoons when lectures were delivered, and escorted over the grounds and through the buildings. Many members came in response to these notices, thus keeping in touch with the development of the Garden.

Publications.

BULLETIN No. 7 was issued April 25, 1902, containing the reports of the officers and committees for the year 1901, and scientific contributions by Mr. F. S. Earle, Mr. R. S. Williams and Dr. Arthur Hollick.

The JOURNAL has been issued monthly during the year and the completed volume contains viii + 242 pages, with 2 plates and 29 figures.

MEMOIRS, Vol. II, consisting of the account of Dr. MacDougal's investigations upon the relations of light and darkness to growth and development, begun in 1895, has been completed and comprises xiii + 319 pages with 176 figures in the text.

CONTRIBUTIONS No. 20–30 inclusive have been printed during the year, embracing the following papers:

No. 20. Seeds and seedlings of *Arisaema triphyllum* and *Arisaema Dracontium*, by Miss R. J. Rennert.

No. 21. Two new western mosses, by Mr. R. S. Williams.

No. 22. Studies on the Rocky Mountain flora — VII, by Dr. P. A. Rydberg.

No. 23. Studies on the Rocky Mountain flora — VIII, by Dr. P. A. Rydberg.

No. 24. The Nidulariaceae of North America, by Miss V. S. White.

No. 25. Notes on American Hepaticae, by Dr. M. A. Howe.

No. 26. Chemical studies of the cocoanut with some notes on the changes during germination, by Mr. J. E. Kirkwood and Dr. W. J. Gies.

No. 27. Some Mt. Desert Fungi, by Miss V. S. White.

No. 28. Fossil ferns of the Laramie Group of Colorado, by Dr. Arthur Hollick.

No. 29. The Polyporaceae of North America — I. The genus *Ganoderma*, by Dr. W. A. Murrill.

No. 30. Studies on the Rocky Mountain flora—IX, by Dr. P. A. Rydberg.

Nos. 1–25 of this series have been taken to constitute Vol. I, and a form containing the table of contents and a title-page has been printed and distributed to subscribers.

Our publications have been in increasing demand from other institutions and from students all over the world. Large editions of them have been published, and the undistributed numbers and volumes occupy a large part of one of the basement rooms in the museum building, where they are conveniently arranged for access.

Exploration.

The value of the plan of detailing members of the staff, from time to time, to visit regions little known botanically has been fully demonstrated, and it is very desirable in the future development of the collections that it should be continued and extended, as rapidly as funds for the purpose can be secured. It is only in this way that many desirable plants and specimens can be obtained, while at the same time substantial contributions to science are made by a study of the material thus secured. The work this year has been accomplished by means of an appropriation of $2,500 from our general fund, and by the following contributions to our special exploration fund:

Andrew Carnegie	$ 600.00
Wm. E. Dodge	600.00
Wm. C. Schermerhorn	250.00
Isaac N. Seligman	100.00
Geo. M. Olcott	100.00
Jas. A. Scrymser	100.00
N. L. Britton	100.00
Samuel Thorne	100.00

L. F. Dommerich	50.00
Miss Elizabeth Billings	50.00
Jas. Douglass	25.00
Mrs. Geo. W. Collard	25.00
Mrs. James H. Aldrich	10.00
Mrs. Esther Herrman	10.00
Theo. F. Jackson	10.00
	$2,130.00

Dr. MacDougal spent about six weeks in Arizona and Sonora in February and March, collecting cactuses and other succulent plants of the desert, and his large collections were received here in good order in April, and at once planted in houses numbers 5 and 6 of the public conservatories, where they have since attracted a great deal of attention. His report on this collecting trip is published in the May issue of the JOURNAL.

Mr. F. S. Earle spent parts of April and May in western Texas and New Mexico, where he obtained a very valuable collection of herbarium specimens representing a large number of species new to science, together with a considerable number of living plants, seeds, and museum specimens. His account of this trip is published in the July number of the JOURNAL.

Mr. Percy Wilson accompanied Dr. A. W. Evans, of Yale University, to Porto Rico in the latter part of June, and spent July and a portion of August in the exploration of the Sierra de Luquillo, the highest mountain range of that island, obtaining living plants, seeds, museum and herbarium specimens of great value to the collections, with many duplicates available for exchange. His report is printed in the JOURNAL for October.

Dr. Marshall A. Howe spent parts of November and December on the Florida Keys, with the special object of studying and securing herbarium and museum specimens of the marine algae of that coast, and brought back a large collection, with many duplicates, representing many species new to our herbarium.

Upon the invitation of the Government of the Island of Jamaica, Mr. F. S. Earle spent about two months toward the close of the year, in an investigation of the fungus and bacterial diseases of economic plants, in company with officials of the Department of Botany of Jamaica, at the same time collecting several thousand specimens of fungi, and some herbarium specimens of other plants. This investigation promises to lead up to economic results of value in tropical agriculture, and to the making known of many species of fungi hitherto undescribed. Mr. Earle also secured, through the coöperation of the Jamaica botanists, 45 living trunks of tree-ferns, representing about 15 species, most of them new to our collections; these were received in good order, planted, and will be a most noteworthy addition to the fern collections in house number 9 of the public conservatories, where some of them are already on display.

At the end of the year, upon an invitation from Mr. Martin Lippman, of this city, who is establishing a plantation in Honduras, Mr. Percy Wilson was sent to accompany him to that country for the purpose of making collections. Inasmuch as the flora of Honduras has been heretofore very little studied, it is anticipated that Mr. Wilson will secure much information, and many specimens of value and importance.

In the early summer of 1901, upon the invitation of gentlemen representing Sir Martin Conway's concessions from the Bolivian Government for the manufacture of india rubber in that country, Mr. R. S. Williams, who had been serving the Garden for some months as a Museum Aid, was detailed to accompany an expedition arranged by Sir Martin Conway, for the purpose of exploring the region, he being employed by the Bolivian company, and passing temporarily out of the employ of the Garden. It was arranged with the Bolivian company that sets of all the specimens secured should become the property of the Garden, on condition that Mr. Williams was given facilities to study his collections here on his return, aided by members of our staff. Mr.

Williams spent some fifteen months in Bolivia, and returned in November, with what is probably the most important botanical collection ever brought out of that part of the world; it is now being studied and arranged, Mr. Williams remaining in the employ of the Bolivian company for some months. The results of this exploration and the study of the material secured will be a grand contribution to botanical science.

The contribution of $600.00 by Mr. Dodge is for the purpose of continuing exploration in the West Indies, especially in the Danish Islands.

As suggested in my last annual report, a special exploration fund which would yield sufficient income for the carrying on such work as that above outlined could be operated by the Garden to very great advantage.

Investigations.

The facilities of the Garden for the furtherance of research have been increased by additions to the collections of books, living, fossil and preserved plants, and to the equipment of the laboratories. Perhaps the most notable advance has been made in the development and organization of the work in horticulture, physiological chemistry and plant pathology.

The results of a large number of completed investigations have been brought out in the publications of the Garden and other periodicals, and others are still in press.

Detailed memoranda of the activities of the members of the staff, and of the members of the faculties of coöperating institutions are given below.

The results described have been accomplished in the intervals of the regular duties connected with the different departments of the Garden, and all of the members of the staff have participated in the guidance of registered investigators.

An account of the work of investigators registered for the privileges of the Garden is to be found in the report of the Director of the Laboratories.

Dr. D. T. MacDougal, first assistant and director of the

laboratories, has published an elementary text-book of plant physiology suitable for use in schools and colleges, and has completed his work upon the relation of light and darkness to growth and development. The results of this extended investigation are being published in Volume II of the Memoirs of the Garden, and the final pages are now coming from the press. Dr. MacDougal made an examination of the desert flora of Arizona, Sonora and Texas in February, and secured many characteristic specimens for the conservatories, which furnish valuable material for many investigations now in progress.

Dr. John K. Small, curator of the museums, has continued his attention to the flora of southeastern United States, and has made critical studies of a number of families, resulting in some important rearrangements. He has made considerable progress in the work upon several genera for the Systematic Botany of North America, the publication of which has been undertaken by the Garden. The preparation of his manual of the flora of the southern United States has been carried forward and is approaching completion.

Dr. P. A. Rydberg, assistant curator, has continued his study of the flora of the Rocky Mountain region and made a critical examination of the Nyctaginiaceae of North America.

Dr. Arthur Hollick, assistant curator, has brought his work upon the Pleistocene flora of the Chesapeake Bay region to a close, and has made critical examinations of a large amount of Cretaceous material from Western America.

Mr. F. S. Earle, assistant curator, made some explorations in western Texas and New Mexico during the earlier portion of the year, and secured much valuable material for the collections. He has determined a great number of specimens of fungi from various regions and paid special attention to the fleshy fungi of the local flora. Professor Earle has continued his critical study of the Agaricaceae and has completed descriptions of the North American species of this group. At the request of the Government of Jamaica he made a tour of investigation of that island and prepared a preliminary report

upon the principal diseases of the cocoanut, banana, cocoa and logwood.

Dr. M. A. Howe, assistant curator, has continued his systematic study of the algae of North America, the results of which have been published in brief articles. Some attention has also been given to the determination of Hepaticae of North America. A field examination of the algal flora of southern Florida was made late in the year and a large amount of valuable material added to the collections. Dr. Howe has also made some experimental observations on the introduction of forms from northerly districts to the waters of Long Island Sound.

Dr. H. H. Rusby, curator of the economic collections, has made notable progress in his work upon the flora of western and northern South America, and has also completed some extensive bibliographical work upon economic plants.

Miss A. M. Vail, librarian, has continued her critical studies of the Asclepiadaceae, and described new species in several genera of this family.

Mr. George V. Nash, head gardener, has continued his work upon the American grasses and economic plants, visiting the botanical gardens at Kew, Paris, Berlin and other places in Europe for the purpose of making examinations of the collections. During this work he has secured a large number of specimens of living material for the conservatories.

Mrs. E. G. Britton, voluntary assistant, has continued her studies of the mosses of North America, and has also worked over collections from the West Indies and South America, brought in various expeditions. A critical examination has been made of the genus *Sematophyllum*, and five thousand specimens properly named and labeled have been added to the systematic collection of mosses. Mrs. Britton has also arranged an exchange of about five thousand specimens.

Mr. R. S. Williams, museum aid, who was detailed on leave to accompany an exploring expedition to eastern Bolivia in July, 1901, returned in November, 1902, bringing a large collection of preserved and living plants from that region,

and is engaged in the study of these plants. A set will become the property of the Garden.

Mr. S. H. Burnham, museum aid, has continued his work upon the flora of Lake George and vicinity.

My own work upon the flora of the West Indies has been carried steadily forward, and critical examinations made of collections from that region brought in various expeditions. A visit was made to the Royal Gardens, Kew, for the purpose of study of type-specimens of Cyperaceae and other groups. Much attention has also been given to a critical study of the Crassulaceae, in the preparation of a revision of that family for the Systematic Botany of North America about to be published by the Garden. A large number of collections from various parts of the world have also been determined, and an examination has been made of material from South America.

Officers of coöperating institutions have also carried on investigation as below.

Dr. L. M. Underwood, professor of botany, Columbia University, has continued his studies of the ferns and fern-allies of North America in the preparation of a series of monographs on this subject. He has also determined a large amount of material belonging to the pteridophytes, from South America.

Professor F. E. Lloyd, adjunct professor of biology in Columbia University, has continued his embryological researches and published brief articles on various subjects, including the vivipary of *Podocarpus*. An advanced stage has been reached in the preparation of a text-book dealing with pedagogical methods in biology.

Dr. H. M. Richards, instructor in botany, Barnard College, has made some investigations upon the influence of wounding upon turgidity.

Dr. C. C. Curtis, tutor in botany, Columbia University, has made some experimental observations upon the influence of various conditions upon transpiration, and obtained data as to the rhythm in this process exhibited by many plants.

Miss Louise B. Dunn, late assistant in botany in Barnard College, made an investigation of the influence of various external factors upon the growth of the capsules of mosses.

Miss Ada Watterson, assistant in botany, Teachers College, has carried out some work in the determination of the influence of various chemical irritants upon respiration of fungi.

Dr. Tracy E. Hazen, assistant in botany, Columbia University, has continued his work upon the Confervae of North America.

Dr. Alex. P. Anderson, assistant in botany, Columbia University, brought his investigations upon the physical properties of starch to an advanced stage early in the year, and is now devoting his entire attention to the economic application of methods of treatment of starchy plant-products for use as foods.

Dr. E. S. Burgess, professor of biology in the Normal College, has completed his bibliographical work on the asters, and his results have appeared as volume 10 of the Memoirs of the Torrey Botanical Club. The critical discussion of the species is nearly completed and will appear in volume 12 of the same series.

Preservation of Native Plants.

The income of the fund of $3,000, established by the Misses Stokes in 1901, was used, as reported in the October Journal, as prizes for essays on this subject, written by Dr. F. H. Knowlton, Miss Cora H. Clark, and Dr. A. J. Grout. These essays were published in the April, May and June issues of the Journal, reprinted in other journals and widely distributed. The movement attracted much public attention and has doubtless been of value in restricting the indiscriminate picking of wild plants; it has led up to the formation of a National Society for the Preservation of Wild Flowers, through which much good will be accomplished.

Reports Appended.

I submit, also, reports by the Curator of the Museums and Herbarium, the Curator of the Economic Collections, the Director of the Laboratories, the Librarian, the Head Gardener, the Superintendent of Buildings and Grounds, and a schedule of expenditures under appropriations by the Board of Managers.

Respectfully submitted,

N. L. BRITTON,

Director-in-Chief.

REPORT OF THE CURATOR OF THE MUSEUMS AND HERBARIUM.

Dr. N. L. Britton, Director-in-Chief, New York Botanical Garden.

Sir: I have the honor to submit herewith my report as Curator of the Museums and Herbarium for the year 1902:

1. General Accessions. The collections composing the Museums and Herbarium have been increased by a total of 67,758 specimens. About 90,000 specimens of plants and plant products have been incorporated in the several permanent collections. Most of these have been prepared and made available for inspection or study, but some are temporarily stored for the want of proper case-equipment. All specimens not needed for the permanent collections of the institution were placed in the duplicate series. The additions to the various collections were derived as follows:

(*a*) *Gifts and Purchases*. By these means the institution has received 19,297 specimens. In addition to the annual appropriation made for the purchase of specimens, friends of the garden have contributed means for the purchase of desirable collections, or have directly presented individual specimens or series of specimens.

(*b*) *Exploration*. A total of 34,496 specimens was obtained through special exploring trips; the great bulk of the material thus secured came from various parts of North America including the tropics and has furnished many valuable and unique specimens.

(*c*) *Exchanges*. Exchanges with institutions and individuals brought 13,965 specimens to the collections. Most of the material thus secured was derived from the larger European botanical gardens and consists of plants mainly from tropical America and the Old World.

In addition to the twenty-six institutions mentioned in my last annual report, exchange relations have been established and maintained with the following:

Carnegie Museum.
University of Arizona.
University of Iowa.
University of Pennsylvania.
University of Lund, Sweden.
Northwestern University.
Colorado College of Agriculture.
Missouri Botanical Garden.
University of Christiania, Norway.
University of Cordoba, Argentine Republic.
Middlebury College.
Botanical Garden, Sydney, New South Wales.
Agricultural and Mechanical College of New Mexico
Botanical Garden, Copenhagen, Denmark.
Botanical Garden, Upsala, Sweden.
Iowa Agricultural College.
Tropical Laboratory, U. S. Department of Agriculture.
Colonial Institute and Museum, Marseilles, France.
Government Botanical Station, New Brighton, New Zealand
University of Alabama.
University of Michigan.
Cornell University.
Brown University.
New York State Museum.

II. Plant Picture Collection. This collection has developed into an important adjunct of the museum system. The acquisition of the Lyon collection of plant pictures and its incorporation with the nucleus of a similar collection described in my last annual report furnishes an ample supply of good plates to draw upon for museum purposes, and fortunately, just at a time when we especially need them. The Garden was fortunate in being able to secure the Lyon collection, which is made up of both black-and-white and colored plates from many of the standard botanical works of the United States, Great Britain and continental Europe. It is estimated to contain 265,000 plates, many of which are accompanied by the original letterpress; this matter together with the plates to which it belongs will in many cases be of great value when incorporated in the herbarium.

III. Plans for New Furniture. The congested condition of all the collections and the prospect of being able to obtain furniture for the museums generally, led to the consideration and formulation of plans for the same early in the year. Ultimately plans were adopted for many pieces of furniture of special design, to accommodate amply and conveniently all the different types of specimens. Especial attention was given to devising the furniture to permit of ready examination and handling of the specimens in the study collections.

Museums.

1. Accessions.* An aggregate of 2,234 specimens was added to the museum equipment, in addition to the many thousands available from the plant picture collections already referred to. As heretofore much of the material came to the institution as unsolicited gifts and by exchanges, and relatively little by purchase. Gifts of desirable material have been temporarily withheld at our request, for the want of permanent or even temporary means of caring for such specimens.

2. Preparation of Material and Appliances for Exhibition. No noteworthy change from the methods of preparation described in previous annual reports has been made, but special devices for the disposition of individual specimens or peculiar types of specimens have been worked out and are gradually being installed. Appliances of a permanent character have been added to the museum equipment as follows :

(*a*) *Exhibition Blocks.* I. Blocks for general museum purposes were secured in the following sizes and quantities, ebonized and placed in the exhibition cases.

Size of block.	Number of blocks.
4 x 4 inches.	304
4¾ x 4¾ "	201
5½ x 4½ "	306
7 x 7 "	190

* For detailed list of accessions see Journal of the New York Botanical Garden, 3 : nos. 25–36.

6 x 12 inches.	46
12 x 12 "	26
Total,	1,073

II. Blocks for the display of fossil specimens, in table cases. A special type of block had to be devised to suit the conditions of the table cases of the fossil plant museum. On account of the thinness of the blocks which it was necessary to adopt, they had to be ebonized by a different method from that used for the style of our general exhibition block and to secure a better display of the specimens, the top of each block has been given a pearl-gray tint. To equip the cases blocks of this type were secured as follows:

Size of block.	Number of blocks.
2 x 3¾ inches.	50
3 x 3¾ "	75
4 x 3¾ "	100
5 x 3¾ "	100
6 x 3¾ "	50
8 x 3¾ "	50
10 x 3¾ "	40
2 x 4¾ "	75
3 x 4¾ "	100
4 x 4¾ "	100
5 x 4¾ "	100
6 x 4¾ "	90
8 x 4¾ "	30
10 x 4¾ "	30
9 x 5 "	60
9 x 6 "	60
9 x 7 "	60
9 x 9 "	100
9 x 12 "	60
Total,	1,330

(*b*) *Glass jars.* (Specimen-jar, 2605, Whitall Tatum Co.)

Diameter.	Height.	Number of jars.
2 inches.	5 inches.	84
2½ "	7 "	36
3 "	8 "	36
3¾ "	10 "	48
4½ "	12 "	96
	Total,	300

(*c*) *Exhibition cards.* (As described in previous reports.)

Size of cards.	Number of cards.
7 x 11 inches.	100
11 x 11 "	200
11 x 14 "	300
14 x 22 "	650
Total,	1,250

(*d*) *Oak frames for displaying specimens mounted on cards, and photographs or plates.* No frames of our standard sizes were secured during the year, but over 600 feet of the moulding was used to make such frames of the standard size as were needed to fill out gaps or to make frames of odd sizes.

3. INSTALLATION. Exhibits of the several museums were improved and strengthened by the addition of specimens generally, as far as our equipment of cases and space allowed.

4. ECONOMIC MUSEUM. Additions have been made to all sections of the economic collection, but no special attempt has been made to accumulate specimens for this museum as the available case room has been very limited. Such specimens as came to the institution unsolicited were either immediately installed in the exhibition cases, or stored in anticipation of additional case-equipment. The departments of foods, beverages and fibers have been specially strengthened, and all the specimens of fibers have been furnished with inconspicuous permanent labels bearing all the original data that accompanied each specimen as it came to the museum.*

5. SYSTEMATIC MUSEUM. Considerable attention has been devoted to the several collections forming this museum.

(*a*) *The synoptic collection.* During the year it has been possible almost completely to furnish this collection with frames and exhibition blocks. Many specimens still await installation on account of the lack of glass jars, but from one end of the series to the other specimens have been added

* For further details concerning the Economic Museum see the report of the Curator of the Economic Collections.

with a view of strengthening the already installed exhibits of the various plant groups.

(*b*) *Local flora*. The popularity of this collection led us to make it as complete as possible at an early date. But as yet we have been unable to install the fungi and most of the algae. Many specimens of these groups have been selected and laid aside in anticipation of the arrival of the additional stands of swinging frames, which we hope to be able to furnish with specimens as soon as they are formally accepted for the institution.

(*c*) *Microscope exhibit*. Early in the year this exhibit was completely renovated. The experience of a year or two indicated the necessity of several changes from the original plan, consequently some changes were made in the glass covering each instrument and a device to keep the instrument in stable focus was added. Since these improvements were incorporated little or no interference from the visiting public has been experienced: a very satisfactory condition, as this exhibit is the most exposed of any in the building.

6. Fossil Plant Museum. Work according to definite plans was begun early in the year on the development of the fossil plant museum and permanent installation has been effected in the Jura-Trias, Cretaceous and Tertiary table-cases and in the Cretaceous, Tertiary and early Paleozoic wall-cases. In the table-cases all specimens have been provided with uniform exhibition blocks, and methods for displaying and labeling specimens in the wall-cases to the best advantage are being tried.

Most of the specimens selected for display have been subjected to careful trimming and developing. Systematic examination of the collections from different localities has been carried on and each individual specimen critically examined and compared with published descriptions or figures, in order to identify any type-specimens. A number of these have been found and marked in the usual manner, by a red star. The examination of the Tertiary, Jura-Trias and Cretaceous material has been completed.

An extensive collection of Pleistocene material from the buried swamps of Maryland was sent for identification and report, and has been added to the Museum collection.

Other notable additions to the museums are: (1) A supplementary collection from the Eolignitic group of Louisiana; (2) a collection from the Miocene Tertiary of the John Day Basin, Oregon; (3) two collections of Cretaceous (Dakota Group) leaves from Kansas.

Considerable rough sorting of miscellaneous material received in boxes from Columbia University has also been accomplished and early in the year the work of designating the ownership of each specimen was completed; thus, in accordance with the plan adopted, specimens belonging to the Garden have each been marked with a yellow B, while each specimen belonging to Columbia University has been marked with a red C.

7. Labeling. The permanent labeling of the several museums has been prosecuted continuously throughout the year. Especial efforts have been made to fill out gaps in the economic museum and the synoptic collection of the systematic museum. The popularity of the local flora of the systematic museum led us essentially to complete the labeling of that collection as far as it is installed early in the year.

The four table-cases in the fossil plant museum containing specimens of the Tertiary, Cretaceous and Jura-Trias have been furnished with permanent labels. In this case a label was adopted giving data concerning the natural family to which the specimen belongs, the name of the geological horizon from which it was derived, the name of the species and the locality.

Large labels for the top of each case of the economic and systematic museums and similar guide-labels for each stand of the local flora collections have been struck off and put in place.

8. Care of the Collections. During the latter part of the year each case of both the economic and systematic museums was completely overhauled and thoroughly dusted

out. In many cases the material was rearranged to better advantage. Inferior specimens have been replaced by better and more illustrative ones whenever this was possible.

Newly received material, as well as older specimens which exhibited any kind of insect depredation, have been poisoned with carbon bisulphide, mercuric chloride or chloroform. The specimens in jars have been kept as fresh in appearance as possible, by repeated cleaning of the dry material and the decanting of material preserved in alcohol, or formaldehyde and water solution. The practice of adding small quantities of formaldehyde to the solution that has stood in the jars for any length of time has been continued, and the results in all cases of the specimens thus preserved have been very satisfactory.

9. Uses of the Museums. The collections comprising the museums have been used in connection with the teaching and development of the garden generally. Teachers, students and whole schools from the city and from neighboring states have used the collections to illustrate courses of study and to gain general information. Especial interest has been manifested in the microscope exhibit and the local flora, both by teachers and students, while manufacturers, importers and merchants have drawn on the economic collections for information.

Herbaria.

1. General Accessions. The total number of specimens derived from various sources and accessioned during the year amounts to 65,374. Many of these have already been mounted and incorporated in the permanent collections and most of the remainder will ultimately find their way there.

The algal collections have been enriched by the acquisition of the complete herbaria of the Rev. Mr. G. W. Perry and Mr. Horace Averill, by miscellaneous exchanges, and by the large collection of Dr. Howe in Florida. The fungal collections have been greatly strengthened by the addition of specimens from all parts of North America and Europe, and

especially by the collections of Mr. Earle in the eastern and southern United States and in Jamaica, West Indies. The number of mosses added to the permanent collections during the year amounted to 8,208. The specimens are from all parts of the world, while a greater number of duplicate mosses, namely, 8,752 specimens, were sent out in exchange. The collection of flowering plants has been greatly strengthened by large additions of specimens from western North America and tropical America.

2. Mounting and Conserving of Herbarium Material. During the year the herbaria have been augmented by 72,583 mounted sheets. This addition represents fully 80,000 specimens, as in the case of the lower cryptogams, several specimens are commonly mounted on a single sheet.

Especial effort was made to reduce the residue of the accumulation of specimens secured in the early years of the Garden's existence, from which accumulation we have for several years past gradually been drawing material to mount as the case demanded, and time allowed. We were quite successful in this effort, and nearly all of the valuable specimens, comprising the several herbaria which the Garden secured several years ago, have been mounted.

The general use of the herbarium, especially in connection with American plants, necessitated getting as many species of the western hemisphere into species-covers as possible at an early date. The purchase of 2,500 pounds of species-covers enabled us to furnish with covers essentially all the North American and such tropical and South American specimens as were needed for immediate study.

All specimens subject to insect ravages have been poisoned with a solution of mercuric chloride and alcohol before being mounted. This method has proved very successful in preventing insect depredations, for since it was put into operation, nearly all signs of insect life have disappeared from the herbarium cases.

3. Disposition of Bulky Herbarium Material. The

collections of bulky material have been developed on the plan outlined in my last annual report. To meet the immediate and pressing demands for means of taking care of such specimens, boxes of the following sizes were secured:

Size of boxes.		Number of boxes.
5/8 x 2 5/8 x 3 3/4 inches.		1,000
1 1/4 x 2 5/8 x 3 3/4 "		3,000
2 1/2 x 2 5/8 x 3 3/4 "		500
1 1/4 x 5 1/4 x 3 7/8 "		1,000
2 1/2 x 5 1/4 x 3 7/8 "		500
2 1/2 x 5 1/4 x 7 3/4 "		200
5 x 5 1/4 x 8 "		200
5 x 5 1/4 x 16 "		50
2 1/2 x 5 1/4 x 16 "		50
	Total,	6,500

4. ARRANGEMENT OF THE HERBARIA. This has been prosecuted on the plan described in my last annual report. The congestion in the cases of the main herbarium room necessitated the building of six new standard herbarium cases which were placed in the morphological laboratory near the herbarium room. To these cases the lichens, hepatics and mosses of the main collection were moved, thus relieving six cases in the large herbarium room. The space thus gained temporarily and partially relieved the congestion of specimens in the cases.

(*a*) *Garden Herbarium.* A total of 65,006 specimens have been accessioned for the Garden herbarium. All the desirable current distributions of herbarium specimens have been secured by gift, exchange or purchase. The collections have been greatly strengthened by the addition of specimens procured on the several exploring trips directly or indirectly under the auspices of the Garden.

About 71,896 sheets were mounted and incorporated in the Garden herbarium. These sheets contain nearly 80,000 specimens. Additions have been made to the local herbarium throughout the year.

(*b*) *Columbia Herbarium.* Herbarium specimens aggre-

gating 368 have been received for the Columbia Herbarium.

All the parts of sheets, resulting from the cutting of an original sheet of standard size, on which two specimens were mounted, have been remounted on new sheets of the proper size and placed in their respective species-covers. The specimens of many genera, especially such as have been critically studied by officers or students, have been furnished with new species-covers.

5. General Duplicate Herbarium. Although during the course of each previous year considerable exchanging has been carried on, with individuals and other institutions, the number of duplicate herbarium specimens increased much faster than we were able to send them out in exchange for others. The already large accumulation was greatly increased by the thousands of duplicate specimens which were derived from the several older herbaria, the mounting of which has been referred to in a previous paragraph.

Fully 25,000 specimens from our duplicate herbarium have been distributed to other institutions from which we have already received other specimens in exchange, or credit which will bring us returns within a year or two.

6. Uses of the Herbarium. The members of the Garden staff have made constant use of this collection in questions relating to the development of the several departments, in the pedagogic work in connection with the courses of instruction for research work, and special investigation. The members of the teaching staff have made similar use of the herbarium. The registered students of both the Garden and Columbia University have had free access to the collections as their studies and investigations demanded.

Officers and students of other institutions and private investigators have from time to time consulted such portions of this collection as their investigations required, while responsible persons generally have drawn on this source of information in regard to special questions.

7. Extra Collections. The two herbaria designed for

undergraduate teaching at Columbia University and Barnard College, mentioned in my last annual report, have been completed as far as available material is concerned and delivered to the above-named institutions. As desiderata come to hand they will be put aside and mounted, until these collections are completed.

8. Assistance. The increasing detail work connected with the maintenance and development of this department has been shared by several members of the staff, volunteers and aids. Dr. Rydberg has attended to most of the curatorial work in connection with the flowering-plant collection. In the case of the cryptogams Professor Underwood has looked after the ferns and fern-allies. Dr. Howe has cared for the Hepaticae and Algae. Mrs. Britton spent much of her time in developing the collection of mosses and related groups. Mr. Earle has cared for the Fungi and Lichenes, while Dr. Hollick spent much time in developing and installing the collection of fossil plants.

To the Museum Aids assigned to this department, especially to those remaining after the reduction of the force, is due much credit for the work accomplished during the year, and the incidental aid of other members of the Garden staff has helped materially in all work.

Respectfully submitted,

J. K. Small,

Curator of the Museums and Herbarium.

December 31, 1902.

REPORT OF THE CURATOR OF THE ECONOMIC COLLECTIONS.

DR. N. L. BRITTON, DIRECTOR-IN-CHIEF.

Sir: I have the honor to submit herewith my report upon the Economic Museum for the year 1902.

Our work during the past year has consisted chiefly in studying the nomenclature of economic products, especially drugs, and in carrying on the labeling and improving the appearance of the collections already in the cases. Owing to the congested condition of the latter, it has not been deemed desirable to push the work of accumulating new material for the present. Donors of collections do not enjoy seeing them placed in storage for long periods, but are usually impatient to visit the museum and see their contributions properly displayed. Considerable new material has, however, been acquired, and, when the conditions permitted, has been placed in the cases; otherwise it has been stored.

Probably the most important of these acquisitions is a collection made in Bolivia by Mr. R. S. Williams, representing chiefly the staple and little known food products of that country. Constituting, as these do, the main subsistence of millions of people, it would appear as though, when properly and generally made known, they must prove of importance to people in other parts of the globe. Among other food products worthy of note are a collection of Canadian and Pacific grains, contributed by Mr. Otto Keusch, of New York. Two important collections of coffees have been presented, one by Mr. A. Wakeman, the other by Mr. C. Claassen, both of New York. The important food products of Porto Rico, mentioned in my last annual report as having been obtained by Professor L. M. Underwood, have been placed in the cases. Many of the specimens obtained by Mr. Percy Wilson in the East Indies, have also been placed in the cases. A number of interesting specimens of Mexican fibers have been obtained from Mr. J. N. Rose, of Washing-

ton. Mr. Albert L. de Lautreppe has contributed a number of cottons obtained in Peru. An interesting set of specimens has been contributed by the Waterman Fountain Pen Co., illustrating the different stages in the conversion of ordinary rubber into the hard rubber of the pen-holder.

Under the new conditions afforded by the large increase of case room, now being supplied, the accumulation of material should be resumed. This work, together with the mounting of materials now stored, and the rearrangements rendered necessary by their installation in the cases will make the coming year one of great activity in this department.

Respectfully submitted,

H. H. Rusby,

Curator of the Economic Collections.

REPORT OF THE DIRECTOR OF THE LABORATORIES.

Dr. N. L. Britton, Director-in-Chief.

Sir: I have the honor to submit the following report for the year ending January 1, 1903.

The appropriation for the laboratories has been expended in purchasing apparatus and in securing the material and supplies necessary for the various investigations carried on in the several departments of the Garden. The facilities devoted to the chemical physiology of plants have been notably increased, and the work in this subject has been placed under the guidance of Dr. W. J. Gies, who has been appointed Consulting Chemist.

Dr. Alexander P. Anderson, assistant in botany, Columbia University, completed his work upon the chemical and physical properties of starch early in the year as a result of which he discovered and perfected a method for the treatment of the starchy portions of plants which yields new products of great economic value as foods, and for use in the arts.

The collection illustrating the history of the microscope has been increased by the donation of six additional instruments with accessories by Mr. C. F. Cox of the Board of Managers, to whose kindness the Garden owes the entire collection.

The meteorological observations have been continued, and the suite of instruments has been removed to a position near the nursery, which offers conditions slightly different from those of the herbaceous grounds in which the observations were made until May 1, 1902. The new Hallock thermograph has been installed to record the temperature of the soil at a depth of 30 cm. (1 foot), and having been operated successfully for a period of eight months, specifications for an improved form of this instrument have been placed in the hands of an instrument-maker who will be able to furnish the Garden and other institutions with a standard form of this

apparatus which promises to be useful in several branches of scientific observation. Some attention has been given to securing accurate data of the range of temperatures in the larger glass houses of the main conservatories.

The photographic equipment has been increased and a number of negatives added to the files showing important natural features of the Garden, plants under cultivation, and the progress made in the various construction operations which have been carried on during the year. Outfits have been furnished the various exploring parties sent out by the Garden and the photographs secured add much to the value of the results of this important branch of the activity of the institution. Lantern-slides have been made from such negatives as were found to offer suitable illustrations for the course of lectures given in the spring and autumn.

I made a tour of six weeks through the desert regions of Arizona, Sonora and Texas, during February and March, for the purpose of securing specimens of the larger cacti and other desert plants for the conservatories, and to make some observations on general vegetative conditions in these regions. Several tons of material were secured, embracing, among other notable specimens, a few tree cacti weighing half a ton each.

Editorial duties in connection with the *Bulletin of the Torrey Botanical Club* and the *Botanisches Centralblatt* have been discharged. A number of lectures have been given in various colleges and laboratories. The duties of General Secretary of the American Association for the Advancement of Science were performed at the Pittsburg meeting of that organization, also the duties of Secretary of the Botanical Society of America. During the absence of Dr. N. L. Britton in England, August 16 to September 13, and at other times for short intervals, the work of the Director-in-Chief was performed by me.

An elementary text-book of plant physiology designed for use in schools and colleges, and containing xii + 138 pages with 108 figures, was completed in February and published shortly afterward by Longmans, Green and Company.

The Board of Trustees of the Carnegie Institution having made an appropriation of $8,000 for the establishment and maintenance of a desert botanical laboratory during the fiscal year 1902–1903, the executive committee of that institution appointed Mr. Frederick V. Coville and myself as an advisory board in relation to the undertaking. This laboratory has been organized for the purpose of making a thorough investigation of the morphological and physiological features of plants under the unusual conditions of light, humidity, moisture and temperature characteristic of desert regions. A resident investigator is to be placed in immediate charge of the laboratory, who will carry out a series of reseaches upon problems outlined by the board. This laboratory will also offer opportunity to trained investigators who may wish to avail themselves of its facilities to solve problems which may be worked out under the conditions mentioned. My duties in connection with this institution will not absorb any considerable amount of my time, nor interfere with the regular performance of my duties at the Garden.

The weekly conventions of botanists at the Garden have been held as noted from time to time in the JOURNAL. This informal organization has proved of great value to its members, as it affords a convenient opportunity for the early presentation of the results of researches by the staff and visiting investigators.

The following persons have been granted the privileges of the institution during the year for more or less extended periods. A brief note is also given as to the nature of the work of every person included in the list:

HARRIET BROWN BAILEY.

The flora of northeastern America with especial attention to the mosses of this region.

HOWARD J BANKER. Syracuse University, A.B., 1892; Columbia University, A.M., 1900. Instructor in biology in the Southwestern State Normal School of Pennsylvania.

A taxonomic study of the Hydnaceae.

JOHN HENDLEY BARNHART. Wesleyan University, A.B., 1892; A.M., 1893; Columbia University, M.D., 1896.

The bibliography of the flora of North America.

ELIZABETH BILLINGS.

A systematic study of the grasses of Vermont.

JEAN BROADHURST. Assistant in botany, Barnard College.

A systematic study of the ferns of the genus *Lomaria*.

CHARLES THOMAS BRUES. University of Texas, B.S., 1901; M.S., 1902.

General morphology of the algae.

ESTHER FUSSELL BYRNES. Bryn Mawr College, A.B., 1891; A.M., 1894; Ph.D., 1898. Instructor in biology in Girls' High School, Brooklyn, N. Y.

An investigation of the factors which determine sex in dioecious plants.

WILLIAM AUSTIN CANNON. Stanford University, A.B., 1899; A.M., 1900; Columbia University, Ph.D., 1902. Later appointed laboratory assistant in the New York Botanical Garden.

The cytology of hybrids, and anatomical and experimental work on propagative bodies.

EDITH SCHWARTZ CLEMENTS. University of Nebraska, A.B., 1898.

An experimental and cultural study of mutation and variation in species.

FREDERIC EDWARD CLEMENTS. University of Nebraska, B.S., 1894; M.A., 1896; Ph.D., 1898. Adjunct professor of botany in the State University of Nebraska.

The completion of various problems in ecological research and ecological nomenclature.

ALICE DUFOUR. Defiance College, Ph.B., 1899.

A systematic study of the grasses of the tribe Oryzeae.

JULIA TITUS EMERSON. Special assistant in plant pathology at Purdue University during a portion of the year 1902.

An investigation of parasitic organisms affecting the roots of *Rosa* and other plants.

ELIZABETH VENABLE GAINES. Adelphi College, A.B., 1899. Instructor in biology in Adelphi College.

A study of the comparative anatomy with some experimental investigations of species of *Tissa*, and also some general work on mosses and fungi.

John Robert Gardner. Fayette College, B.S., 1890; State University of Iowa, C.E., 1894.

A taxonomic study of the Celastraceae of North America.

Leon Everett Grout. University of Vermont, B.S., 1902.

The embryology of certain members of the Rubiaceae.

Benjamin Charles Gruenberg. University of Minnesota, B.S., 1896. Sugar-testing laboratory, U. S. Appraisers' Stores, N. Y. City. Instructor of biology in High Schools, N. Y. City.

Chemical and anatomical examination of *Haematoxylon*.

Lenda Tracy Hanks. Columbia University, B.A., 1901; M.A., 1902. Later appointed museum aid in the New York Botanical Garden.

Studies in the general morphology of the seed-plants.

Roland McMillan Harper. University of Georgia, C.E., 1897.

The flora of Georgia.

Caroline Coventry Haynes.

A systematic study of some of the Hepaticae.

Florence Henry. Cornell University, B.A., 1901; Columbia University, M.A., 1902.

The fossil flora of a region in the eastern United States.

Homer Doliver House. Syracuse University, B.S., 1902. Later appointed assistant in botany, Columbia University.

A systematic and anatomical study of the Convolvulaceae, and an experimental series of observations on carpotropic movements.

Flora Isham.

A taxonomic study of the sedges of the local flora.

Joseph Edward Kirkwood. Pacific University, B.A., 1898; Princeton University, M.A., 1902. Instructor in botany in Syracuse University.

The embryology of the Cucurbitaceae, and chemical and anatomical study of the cocoanut and its changes during germination.

Elsie M. Kupfer. Columbia University, B.A., 1899; M.A., 1901. Instructor in biology in Long Island City High School.

An anatomical and physiological study of *Baccharis genistelloides*, and a series of studies upon the subject of regeneration of plants.

George Leavenworth. University of Missouri, B.A., 1902.

A systematic study of the trees of the Mississippi basin.

Emily Pauline Locke. Smith College, B.L., 1900.
Studies in the general embryology of the seed-plants.

Nina Lovering Marshall. Wellesley College, B.A., 1895. Instructor in science department of Ely's School, N. Y. city.
A study of the mosses, lichens and fungi of the local flora in the preparation of a popular book upon this subject.

Ernestine Molwitz. Columbia University, B.A., 1902.
An anatomical and chemical examination of *Ibervillea Sonorae.*

Fannie Augusta Mulford.
A study of the flora of Long Island.

William Alphonso Murrill. Virginia Polytechnic Institute, B.S.A., 1886; B.M. and B.S., 1887; Randolph-Macon College, B.S., 1889; B.A., 1890; M.A., 1891; Cornell University, Ph.D., 1900.
A systematic study of the Polyporaceae of North America.

Edith Edwina Rand. Smith College, B.A., 1899.
A cytological investigation of tendrils and other irritable organs.

Rosina Julia Rennert. Normal College of N. Y. City, B.A., 1897; Columbia University, B.A., 1901; M.A., 1902.
An anatomical and physiological study of *Oxypolis filiformis.*

Winifred Josephine Robinson. Michigan State Normal School, B.Pd., 1892; University of Michigan, B.S., 1899.
The physiology of the formation of tubers, and a taxonomic study of certain groups of ferns.

William Keller Rubrecht. Muhlenberg College, B.A., 1901.
A study of certain algae and fungi.

Augustine Dawson Selby. Ohio State University, B.S., 1893. Botanist and chief of the department of plant physiology and pathology of the Ohio Agricultural Experiment Station.
Investigations in the chemical physiology of plants, and of fungal parasites affecting the grape.

Hervey Woodburn Shimer. Lafayette College, B.A., 1899; M.A., 1901.
The fossil flora of a selected locality.

Cornelia Janney Shoemaker. Swarthmore College, B.A., 1894. Instructor in Friends' Seminary, N. Y. City.
An auxanometric study of growth.

Margaret Slosson.

An experimental study of *Asplenium ebenoides,* demonstrating its hybrid character.

Stella Georgiana Streeter. Smith College, B.L., 1898.

A study of the transpiratory openings of the Marchantiaceae.

William Cullen Uhlig. Columbia University, Ph.B., 1896.

General morphology of the algae in the water supply of New York City.

Dorris Whipple, Jr. New York College of Pharmacy, Ph.G., 1901.

Cultural investigation of virulent and pathogenic bacteria. Investigation of the bacterial flora of the water supply of New York City.

Violette S. White.

A taxonomic study of the Nidulariaceae of North America. An enumeration of the fungi of Mt. Desert Island.

Charles Zeleny. University of Minnesota, B.S., 1898; M.S., 1901.

An experimental investigation of correlations, comprehending a study of the dimensional relations of the members of compound leaves.

The total registration for the year 1902 amounts to 43. The persons granted the privileges of the institution for the year have received baccalaureate and graduate degrees from thirty-one different colleges and universities.

Every available table and desk in the herbarium and laboratories that could be assigned for personal use has been occupied during the greater part of the year, and the accommodation of an additional number of investigators must await the completion of furniture and fittings now under construction.

Respectfully submitted,

D. T. MacDougal,

First Assistant and Director of the Laboratories.

REPORT OF THE LIBRARIAN.

To the Director-in-Chief.

Sir: I have the honor to submit the following report on the Library, covering the period from January 1, 1902, to January 1, 1903.

A census of the Library was taken on December 29, and the number of bound volumes was then found to be 12,935, showing an increase for the year of 1,962 volumes. Of these, 610 volumes were purchased by the Special Book Fund, 383 volumes were purchased by the Library Appropriation, 263 volumes were presented to the Garden and 44 volumes were deposited by Columbia University, the remainder being acquired through subscription or exchange.

During the year 881 volumes have been bound, of which 135 volumes were serials and pamphlets deposited by Columbia University. A number of old books have been repaired and many books reclassified and renumbered.

The card-catalogue has been kept fairly up to date and about 6,800 written cards have been added to it in addition to the printed sets of index cards of the Torrey Botanical Club.

The most important addition to the Library is a collection of between four and five hundred volumes that were purchased in Berlin during the summer and which illustrate the earlier Pre-Linnean Botany and Natural History.

Valuable gifts have been received from time to time from Miss V. S. White, Dr. Haslett McKim and Dr. C. G. Am Ende.

The duplicate working collections of books in the Laboratory and Herbarium have materially increased, necessitating new shelves in both departments.

Accessions to the Library, other than serials and regular exchanges, have been published monthly in the Journal.

Respectfully submitted,

Anna Murray Vail,

Librarian.

List of Exchanges.

Institutions.

Agricultural Experiment Station, Auburn, Ala.
" " " Tuskegee, Ala.
" " " Uniontown, Ala.
" " " Tucson, Arizona.
" " " Fayetteville, Ark.
" " " Berkeley, Calif.
" " " Fort Collins, Colo.
" " " New Haven, Conn.
" " " Storrs, Conn.
" " " Newark, Del.
" " " Lake City, Fla.
" " " Experiment, Ga.
" " " Moscow, Idaho.
" " " Urbana, Ill.
" " " Lafayette, Ind.
" " " Ames, Iowa.
" " " Manhattan, Kans.
" " " Lexington, Ky.
" " " Baton Rouge, La.
" " " Orono, Me.
" " " College Park, Md.
" " " Amherst, Mass.
" " " Agricultural College, Mich.
" " " St. Anthony Park, St. Paul, Minn.
" " " Agricultural College, Miss.
" " " Columbia, Mo.
" " " Bozeman, Montana.
" " " Lincoln, Nebr.
" " " Reno, Nev.
" " " Durham, N. H.
" " " New Brunswick, N. J.
" " " Mesilla Park, N. Mex.
" " " Geneva, N. Y.
" " " Ithaca, N. Y.
" " " Raleigh, N. C.
" " " Fargo, N. Dak.
" " " Wooster, Ohio.

Agricultural Experiment Station, Stillwater, Oklahoma.
" " " Corvallis, Oregon.
" " " State College, Pa.
" " " Porto Rico, W. I.
" " " Kingston, R. I.
" " " Clemson College, S. C.
" " " Brookings, S. Dak.
" " " Knoxville, Tenn.
" " " College Station, Texas.
" " " Logan, Utah.
" " " Burlington, Vt.
" " " Blacksburg, Va.
" " " Morgantown, W. Va.
" " " Pullman, Washington.
" " " Madison, Wis.
" " " Laramie, Wyo.

Agricultural Bulletin of the Malay Peninsula, Singapore, Straits Settlement.

Agricultural Department of the West Indies, Barbadoes, W. I. *Bulletin* and *Agricultural News.*

American Museum of Natural History, New York City, N. Y. *Journal.*

Bergianska Trădgården, Stockholm, Sweden. *Acta Horti Bergiani.*

Bernice Pauahi Bishop Museum, Honolulu, Hawaii.

Botanic Gardens, Singapore, Straits Settlement. *Annual Report.*

Botanic Gardens, Sydney, New South Wales. *Report.*

Botanic Institute of the University of Stockholm, Stockholm, Sweden. *Meddelanden.*

Botanical Department, Jamaica, West Indies. *Bulletin.*

Botanical Gardens, Cincinnati, Ohio.

Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y. *Science Bulletin.*

California State Board of Horticulture, Sacramento, California. *Report.*

Central Experiment Farm, Ottawa, Canada. *Bulletin*, *Report.*

Chicago University, Chicago, Illinois. *Contributions from the Hull Botanical Laboratory.*

Clara Leigh Dwight Gardens, Mount Holyoke, Mass. *Seed Lists.*

College of Pharmacy, New York City, N. Y. *Journal of Pharmacology.*

Columbia University, New York City, N. Y. *Memoirs* and *Contributions from the Department of Botany.*

Denison University, Granville, Ohio. *Bulletin of the Scientific Laboratories.*

Eli Lilly and Company, Indianapolis, Ind.

Field Columbian Museum, Jackson Park, Chicago, Ill. *Publications: Report Series* and *Botanical Series.*

Geological and Natural History Survey of Canada, Ottawa, Canada. *Contributions from the Herbarium.*

Geological and Natural History Survey of Maryland, Baltimore, Md.

Geological and Natural History Survey of Minnesota, Minneapolis, Minn. *Report* and *Bulletin.*

Hamburgische Botanische Staatsinstitute, Hamburg, Germany. *Seed Lists.*

Harvard University, Cambridge, Mass. *Contributions from the Gray Herbarium*, and *Contributions from the Cryptogamic Laboratory.*

Herbier Boissier, Geneva, Switzerland. *Bulletin.*

Hortus Botanicus, Christiania, Norway. *Seed Lists.*

Hortus Botanicus, Lund, Sweden. *Seed Lists.*

Hortus Botanicus, Utrecht, Holland. *Seed Lists.*

Hortus Thenensis, Tirlemont, Belgium. *Icones selectae.*

Illinois State Laboratory of Natural History, Urbana, Ill. *Bulletin.*

Institut Agronomique de Moscou, Moscow, Russia. *Annales.*

Institut Botanique de l'Université, Brussels, Belgium. *Recueil.*

Institut Botanique de l'Université, Liege, Belgium. *Archives.*

Institut Botanique, Montpellier, France. *Seed Lists.*

Institut Colonial de Marseille, Marseilles, France. *Annales.*

Instituto Fisico-Geografico de Costa Rica, San Jose de Costa Rica. *Boletin.*

Instituto Medico Nacional, Mexico City, Mexico. *Anales.*

Iowa Academy of Sciences, Des Moines, Iowa. *Proceedings.*

Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa. *Contributions from the Botanical Laboratory.*

Jardin d'Acclimatation Alpin, Geneva, Switzerland. *Seed Lists.*

Jardin Botanico de la Universidad, Havana. Cuba.

Jardin Botanique, Geneva, Switzerland. *Bulletin du Laboratoire Général* and *Annuaire.*

Jardin Botanique de Buitenzorg, Batavia, Java. *Mededeelingen, Verslag* and *Bulletin.*

Jardin Botanique, Parc de le Tête d'Or, Lyon, France. *Seed Lists.*

Jardin Botanique de la Faculté Mixte de Médecine et de Pharmacie, Lyon, France. *Seed Lists.*

Jardin Botanique de l'Université de Groningue, Groningue, Holland. *Seed Lists.*

Jardin Botanique "Jevremovac," Belgrade, Servia. *Seed Lists.*

Johns Hopkins University, Baltimore, Md. *Circulars.*

Kansas University Quarterly, Lawrence, Kansas.

Königl. Botanischer Garten, Munich, Bavaria. *Seed Lists.*

Königl. Botanischer Garten und Museum zu Berlin, Berlin, Germany. *Notizblatt.*

Leland Stanford Jr. University: Hopkins Seaside Laboratory, San Francisco, Cal. *Contributions.*

Leyden Botanic Garden, Leyden, Holland. *Delectus Seminus.*

Lloyd Mycological Museum, Cincinnati, Ohio. *Report; Mycological Notes, Reproduction Series,* and *Bulletin.*

Manchester Institute of Arts and Sciences, Manchester, England. *Proceedings.*

Manchester Museum, Owens College, Manchester, England. *Reports* and *Publications.*

Missouri Botanical Gardens, St. Louis, Mo. *Report.*

Museo Nacional de Montevideo, Montevideo, Uruguay. *Anales.*

National Botanic Garden, Washington, D. C.

New Jersey Agricultural Experiment Station, Trenton, N. J. *Report of the Botanical Department.*

New York Public Library, New York City, N. Y. *Bulletin.*

New York State Museum of Natural History, Albany, N. Y. *Annual Report.*

Oberlin College, Oberlin, Ohio. *Laboratory Bulletin.*

Queens College Library, Kingston, Ontario, Canada.

R. Orto Botanico di Palermo, Italy. *Bollettino.*

R. Orto Botanico di Siena, Siena, Italy. *Bullettino.*

R. Scuola Superiore di Agricoltura in Portici, Portici, Italy. *Annali* and *Bollettino.*

R. Stazione Agraria Sperimentale, Rome, Italy. *Bollettino.*

Royal Botanic Gardens, Trinidad, West Indies. *Bulletin of Miscellaneous Information.*

Royal Botanical Gardens, Calcutta, India. *Annals.*

Royal Botanic Garden, Edinburgh, Scotland. *Seed Lists.*

Royal Botanical Garden, Glasnevin, Dublin, Ireland. *Seed Lists.*

Royal Gardens, Kew, England. *Bulletin of Miscellaneous Information.*

St. Petersburg Botanical Garden, St. Petersburg, Russia. *Bulletin* and *Acta.*

Sharon Biological Laboratory, Sharon, Mass.

Shaw School of Botany, St. Louis, Mo. *Contributions.*

Smith College, Northampton, Mass. *Seed Lists.*

Smithsonian Institution, Washington, D. C. *Report.*

Teachers College, Columbia University, New York City. *Journal of Geography.*

U. S. Department of Agriculture. *All publications.*

Weather Bureau and its 44 Sectional Departments.

Monthly Weather Review.

U. S. Department of State. *Publications of the Bureau of Foreign Commerce.*

U. S. Geological Survey, Washington, D. C. *Annual Report*, *Bulletin.*

University of California, Berkeley, California. *Contributions from the Botanical Seminary*, *Contributions from the Botanical Laboratory* and *Publications: Botany.*

University of Colorado, Boulder, Colo. *Studies.*

University of Nebraska, Lincoln, Neb. *Contributions from the Botanical Department.*

University Library, Upsala, Sweden. *Botanic Reprints.*

Victoria Gardens, Bombay, India. *Report.*

Societies.

Académie Impériale des Sciences, St. Petersburg, Russia. *Bulletin.*

Academy of Natural Sciences, Philadelphia, Pa. *Proceedings.*

American Association for the Advancement of Science, Washington, D. C. *Proceedings.*

American Rose Society, New York City, N. Y. *Bulletin.*

Appalachian Mountain Club, Boston, Mass. "*Appalachia.*"

Asiatic Society of Bengal, Calcutta, India. *Journal.*

Association pour la Protection des Plantes, Geneva, Switzerland. *Bulletin.*

Biological Club of the Ohio State University, Columbus, Ohio. *The Ohio Naturalist.*

Biological Society of Washington, Washington, D. C. *Proceedings.*

Botanical Club of Canada, Halifax, Canada. *Annnal Report.*

Botanical Society of America. *Publications.*

Botanische Gesellschaft zu Regensburg, Regensburg, Bavaria, Germany. *Denkschriften.*

Botanischer Verein der Provinz Brandenburg, Berlin, Germany. *Verhandlungen.*

Botanischer Verein in Landshut, Landshut, Bavaria. *Bericht.*

Buffalo Society of Natural Sciences, Buffalo, N. Y. *Bulletin.*

California Academy of Sciences, San Francisco, Cal. *Proceedings.*

Cincinnati Society of Natural History, Cincinnati, Ohio. *Journal.*

Connecticut Academy of Arts and Sciences, New Haven, Conn. *Transactions.*

Davenport Academy of Sciences, Davenport, Iowa. *Proceedings.*

Edinburgh Botanical Society, Edinburgh, Scotland. *Transactions.*

Elisha Mitchell Scientific Society, Chapel Hill, N. C. *Journal.*

Flower Preservation Society of America, Washington, D. C. *Circulars.*

Geographical Society of Philadelphia, Philadelphia, Pa. *Bulletin.*

Hamilton Scientific Association, Hamilton, Ontario. *Journal and Proceedings.*

Horticultural Society of New York, New York City, N. Y. *Reports.*

Indiana Horticultural Society, Indianapolis, Ind. *Transactions.*

Indianapolis Academy of Science, Indianapolis, Ind. *Proceedings.*

Kansas Academy of Sciences, Topeka, Kansas. *Transactions.*

K. K. Zool. Bot. Gesellschaft, Vienna, Austria. *Verhandlungen.*

La Murithienne. Société Valaisanne d'Histoire Naturelle, Sion, Valais, Switzerland. *Bulletin de la Murithienne.*

Land und Forstwirtschaft in Deutsch-Ostafrika, Heidelberg, Germany. *Berichte.*

Massachusetts Horticultural Society, Boston, Mass. *Transactions.*

Michigan Academy of Science, Ann Arbor, Mich. *Report.*

Michigan Horticultural Society, Lansing, Michigan. *Annual Report.*

Minnesota Horticultural Society, Minneapolis, Minn. *Transactions.*

Natural History Association of Miramichi, Chatham, New Brunswick. *Proceedings.*

Natural History Society of New Brunswick, St. John, New Brunswick. *Bulletin.*

Natural Science Association of Staten Island, New Brighton, N. Y. *Proceedings.*

Naturforschende Gesellschaft in Basel, Basel, Switzerland. *Verhandlungen.*

Naturforschende Gesellschaft in Zürich, Zürich, Switzerland. *Vierteljahrsschrift.*

Naturhistorische Gesellschaft zu Nürnberg, Nürnberg, Germany. *Abhandlungen.*

New Jersey State Horticultural Society, Trenton, N. J. *Proceedings.*

New York Academy of Sciences, New York City, N. Y. *Annals.*

New York Farmers, New York City, N. Y. *Proceedings.*

New York Zoölogical Society, New York City, N. Y. *Report.*

Nova Scotian Institute of Science, Halifax, N. S. *Proceedings and Transactions.*

Pennsylvania Forestry Association, Philadelphia, Pa. *Forest Leaves.*

Physiographiske Forening i Christiania, Christiania, Norway. *Nyt Magazin for Naturvidenskaberne.*

Portland Society of Natural History, Portland, Me. *Proceedings.*

Rochester Academy of Sciences, Rochester, N. Y. *Proceedings.*

Royal Botanic Gardens, Peradeniya, Ceylon. *Annals.*

St. Louis Academy of Natural Sciences, St. Louis, Mo. *Transactions.*

Santa Barbara Society of Natural History, Santa Barbara, California. *Bulletin.*

Schweizerische Botanische Gesellschaft, Bern, Switzerland. *Berichte.*

Sociedad Científica Argentina, Buenos Aires, La Plata, So. A. *Anales.*

Sociedad Mexicana de Historia Natural, Mexico City, Mexico. "*La Naturaleza.*"

Sociedade Broteriana, Jardim Botanico, Coimbra, Portugal. *Boletim.*

Société Botanique, Université de Gand, Belgium. "*Dodonea.*"

Société Botanique du Grand Duché de Luxembourg, Luxembourg, Grand Duché de Luxembourg. *Recueil.*

Société d'Histoire Naturelle de Macon, Macon, France. *Bulletin.*

Société des Naturalistes Luxembourgeois, Luxembourg, Grand Duché de Luxembourg. "*Fauna.*"

Société Impériale des Naturalistes de Moscou, Moscow, Russia. *Bulletin.*

Société Linnéenne de Paris, Paris, France. *Bulletin Mensuel.*

Societe Royale de Botanique de Belgique, Brussels, Belgium. *Bulletin.*

Society for Plant Morphology and Physiology. *Publications.*

Society for the Preservation of Native Plants, Boston, Mass. *Leaflets.*

Society of American Florists, Boston, Mass. *Proceedings.*

Southern California Academy of Sciences, Los Angeles, Cal. *Bulletin.*

Texas Academy of Science, Austin, Texas. *Transactions.*

Torrey Botanical Club, New York City, N. Y. *Bulletin*, *Memoirs*, *Torreya.*

University of Wisconsin Library, Madison, Wis. *Bulletin.*

Videnskabs-Selskabet, Christiania, Norway. *Skrifter.*

Washington Academy of Sciences, Washington, D.C. *Proceedings.*

Wisconsin Academy of Arts and Sciences, Madison, Wis. *Transactions.*

Wisconsin Natural History Society, Milwaukee Public Museum, Milwaukee, Wis. *Proceedings.*

Journals.

American Agriculturist, New York City, N. Y.

American Botanist, Binghamton, New York.

American Florist, Chicago, Ill.

American Gardening, New York City, N. Y.
American Journal of Pharmacy, Philadelphia, Pa.
American Monthly Microscopical Journal, Washington, D.C.
Botanical Gazette, Chicago, Ill.
Botaniska Notiser, Lund, Sweden.
Bulletin of Pharmacy, Detroit, Mich.
California Floriculturist, Los Angeles, Cal.
Chicago Hardwood Record, Chicago, Ill.
Country Life in America, Ithaca, N. Y.
Florist's Exchange, New York City, N. Y.
Gamophyllous, Plainfield, N. J.
Gardening, Chicago, Ill.
India Rubber World, New York City, N. Y.
Journal of Applied Microscopy, Rochester, N. Y.
Journal of Mycology, Columbus, Ohio.
Magyar Botanikai Lapok, Budapest, Hungary.
Mayflower, Floral Park, Long Island, N. Y.
Mazama, Portland, Oregon.
Meehans' Monthly, Germantown, Pa.
Muhlenbergia, Lancaster, Pa.
Nuova Notarisia, Padua, Italy.
Ottawa Naturalist, Ottawa, Canada.
Park and Cemetery, Chicago, Ill.
Pharmaceutical Record, New York City, N. Y.
Pharmaceutical Review, Milwaukee, Wis.
Pittonia, Washington, D. C.
Plant World, Washington, D. C.
Popular Science Monthly, New York City, N. Y.
Revue Bryologique, Cahan, Athis, France.
Revue Horticole, Paris, France.
Revue de l'Horticulture Belge et Etrangère, Ghent, Belgium.
Rural New Yorker, New York City, N. Y.
Science, New York City, N. Y.
Vick's Illustrated Monthly Magazine, Rochester, N. Y.
West American Scientist, San Diego, Calif.
Zoe, San Diego, Calif.

Periodicals Subscribed for by the Garden.

Académie Internationale de Géographie Botanique, Le Mans, France. *Bulletin, Chronique trimestrielle.*

Beiträge zur Wissenschaftlichen Botanik, Stuttgart, Germany.
Biltmore Botanical Studies, Biltmore, N. C.
Biologisches Centralblatt, Leipzig, Germany.
Biometrika, London, England.
Bryologist, Brooklyn, N. Y.
Bulletin du Jardin Colonial et des Jardins d'Essai des Colonies Françaises, Paris, France.
Centralblatt für Bacteriologie: *Abtheilung I.–II.*
Forestry and Irrigation, Washington, D. C.
Hoppe-Seyler's Zeitschrift für Physiologische Chemie, Strassburg, Germany.
House and Garden, Philadelphia, Pa.
Jardin Botanique de Buitenzorg, Batavia, Java. *Annales.*
Journal d'Agriculture Tropicale, Paris, France.
La Cellule, Lièrre, France.
Le Botaniste, Poitiers, France.
Lindenia, Brussels, Belgium.
Nature, London, England.
New England Botanical Club, Boston, Mass. "*Rhodora.*"
Orchid Review, London, England.
Royal Horticultural Society, London, England. *Journal.*

Periodicals Subscribed for by Columbia University and Deposited at the Garden.

Allgemeine Botanische Zeitschrift, Karlsruhe, Germany.
Annales des Sciences Naturelles: Botanique, Paris, France.
Baumgarten, Jahresbericht über Pathogenen Mikroorganismen, Braunschweig, Germany.
Bibliotheca Botanica, Stuttgart, Germany.
Botanische Jahrbücher, Leipzig, Germany.
Botanische Zeitung, Leipzig, Germany.
Botanischer Jahresbericht (Just's), Leipzig, Germany.
Botanisches Centralblatt, Cassel, Germany.
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REPORT OF THE HEAD GARDENER.

To the Director-in-Chief.

Sir: I have the honor to submit herewith my report as head gardener for the year 1902.

General Horticultural Operations.

For the prosecution of this work I have had the assistance of the following force: Mr. Geo. A. Skene, second gardener, who has taken care of its immediate direction; two foreman-gardeners, three foremen, eleven gardeners, six apprentices, one driver, and a varying number of laborers ranging from five to seven.

For the first few weeks the force employed at the conservatories consisted of one foreman, six gardeners, and one apprentice. Later, upon the completion of the conservatories, this was increased. For purposes of better management, and that each man in a position of responsibility might have time to devote to actual work among the plants under his control, it was decided to divide the responsibility and have two foreman-gardeners, one to take charge of the central palm-house and of all the houses to the east, the other to control the remainder, including also the care of the cellar and of the driveway thereto. In addition to these two foreman-gardeners, seven gardeners and four apprentices have been assigned to duty here.

For the propagating houses and nurseries one foreman and three men, two of them apprentices and the third a laborer, have been required. The growth of the collections and the increased activity in the experimental work carried on here have required a larger force than that of last year to satisfactorily accomplish the work. In addition to the care of the propagating houses this force has kept the nurseries free of weeds and the soil properly cultivated, and has also maintained the walks and roads of this tract and the surroundings of the houses in proper condition. At the approach of cold

weather one apprentice and the laborer were withdrawn and their services used elsewhere. Early in the summer the larger part of the plants were removed from the houses and plunged in the soil in partial shade. This considerably reduced the amount of work necessary for their care and at the same time benefited the plants, which were again transferred to the houses before danger of frost.

The herbaceous grounds have required the services of one foreman and two laborers. This force has attended to all the gardening in this tract, and has done with hand-machines all the mowing which it was impossible to accomplish with the horse-mower. The viticetum was also kept in shape by these men.

To one foreman and three laborers was confided the care of the lawns, including such mowing as could not be done with the horse-mower; the west border, as far as the lake; and the beds of shrubbery and the circles around the trees and shrubs in the area lying between the Southern Boulevard and the museum. Such time as was not thus employed was devoted to the care of the fruticetum and the arboretum, including the pinetum. One gardener and a laborer were reserved as a movable factor, and their services used where most needed; they were employed a part of the time in caring for the west border north of the lake and for the north border; in miscellaneous scythe-work: in removing brush; and in helping with the care of the fruticetum and the arboretum.

The driver with a horse, wagon and mower, detailed to my department, was employed in keeping the lawns mowed in the neighborhood of the museum and conservatories and the areas along the main driveways, excepting such portions as required mowing by hand machines; and in hauling supplies for the conservatories and propagating houses, moving plants back and forth between these buildings, and removing rubbish from plantations and buildings.

The usual mulching of beds and trees and shrubs has been attended to; the raking and piling of leaves for the production of leaf-mold is in progress at such times as the weather

will permit; and the removing of dead trees and of dead branches from living trees is going on as opportunity presents.

Decorative Plantations.

The shrub beds planned for the areas lying between the walks and roads in the neighborhood of the Southern Boulevard entrance have been planted, as have also those between the service and driving roads opposite the approach to the elevated railroad. This approach has necessitated the rearrangement of the border at that point. To accomplish this satisfactorily it was necessary to remove and replant the larger part of the trees and shrubs already there, and to incorporate about 250 more. The planting of the bed in the triangle south of the museum, left unfinished last fall, was completed during the spring. A partial planting of the tree borders of the approach to the museum was effected by placing Carolina poplars 50 feet apart; these are to be alternated later with tulip-trees, the poplars to be eventually removed.

That portion of the shrub and herbaceous border extending along the Harlem Railroad as far as the site for the Mosholu Parkway bridge, has received attention during the fall. Such shrubs as required more space were moved forward. The herbaceous plants in front of these were all removed, the ground thoroughly cultivated and manured, and the plants again arranged, incorporating at the same time many species from the nurseries which had not hitherto been represented in this plantation.

Systematic Plantations.

In the herbaceous grounds it has been necessary to enlarge many of the beds and to make additional ones for some of the families. The bed of the nettle family was enlarged, as was also one each of the buckwheat, crowfoot, rose, geranium, madder and sunflower families. Two additional beds were provided for the rose family, and one each for the mallow and sunflower families. This collection, including such additional species in the nurseries as will be moved over in the

spring, remains about the same as last year. The aspect of this collection must constantly change, owing to the instability in this climate of many species which are but imperfectly adapted to their new environment.

The vigorous growth of the shrubs in the fruticetum, and the crowding consequent thereupon, has made desirable a complete rearrangement of this collection. Experience has shown that for systematic collections it is better to treat each shrub individually, keeping a cultivated circle around it, instead of massing in beds. The cost of maintenance will not be thus increased, and the availability of the collections for the purposes of scientific work and for general inspection will be much enhanced, as the shrubs will be planted far enough apart to allow of freely passing among them. In accordance with this plan a beginning was made late in the fall, and the following families rearranged: willow, birch, beech, elm, mulberry, crowfoot, cercidiphyllum, barberry, strawberry-shrub, and a part of the roses. Eighteen species of willows were moved into the collection from the nursery, but otherwise it remains about as it was the previous year.

The salicetum, deciduous aboretum, viticetum and the pinetum remain about as they were, awaiting the completion of roads and paths before active work on them is begun.

Propagating Houses and Nurseries.

The usual horticultural and experimental work has been carried on here, one house and portions of the nurseries, as was the case last year, having been given exclusively to this latter purpose. The enlargement of the collections and the increased activity in the experimental work has added considerably to the work, and has more than crowded these houses, and made the early completion of this range much desired. These houses must accommodate not only the results of constant propagation, but must serve also as store-houses for the reception of such plants from the large conservatories as need rest or special treatment.

About 1,600 packets of seed have been sown. Of these seeds many have germinated, and from this source have been obtained about 4,000 plants. Many of these have already been incorporated with the collections, while others are still too small.

Public Conservatories.

It is upon the collections here installed that the largest amount of work has been done, not only in securing additional material, but also in naming, classifying and arranging. Upon the completion of the new part of this range early in the year, a thorough rearrangement of this collection was entailed, in order that the family groups might be maintained and their relationship one to the other preserved in so far as possible. The following general plan, which has been found quite satisfactory from a systematic standpoint, was adopted: to the central or palm house were allotted the larger palms and cycads, the larger bamboos, and the cyclanthus family; house no. 2 is devoted to the aroids, bromeliads and pitcher-plants; no. 3 to the tropical members of the amaryllis, spider-wort, tacca, maranta, and a part of the lily and iris families; no. 4 to a miscellaneous tropical collection, including the bananas, various species of *Pandanus*, and the canna family, and of other families many specimens which were too large to be placed in their proper groups in the smaller houses; nos. 5 and 6 to the succulents; nos. 7 and 8 to the poly-petalous tropical plants; no. 9, the tank house, to aquatics, sedges, and the smaller grasses; nos. 10 and 11 to the ferns, the latter to the tree ferns; nos. 12 and 13 to the temperate collections; no. 14 to the gamopetalous tropical plants; and no. 15 mainly to the tropical orchids, the middle portion of the center bench also receiving the smaller palms and cycads.

Many additions have been made, by exchange with European institutions and with others in this country, by gifts from members of the Garden and other friends which have been recorded in the JOURNAL from time to time, by exploration, and from seeds procured from various sources. The aspect of the collection is constantly changing, owing to the necessity

of removing plants at their stated periods of rest to the propagating houses. There are now in the conservatory collections, including such as are transiently at the propagating houses, about 5,800 species and varieties. There are at present in the conservatories about 12,000 plants, and at the propagating houses about 9,000. The following table indicates the number of species represented in some of the larger or more conspicuous groups.

Palm family		130
Cycad family		10
Cyclanthus family		9
Aroid family		179
Fern family		394
Pine-apple family		175
Banana family		28
Pandanus family		10
Orchid family		364
Succulents:		
Cactus family	505	
Lily family	184	
Pine-apple family	11	
Carpet-weed family, represented by the genus *Mesembryanthemum*	76	
Spurge family	54	
Milk-weed family, represented mainly by the genus *Stapelia*	51	
Sunflower family	26	
Amaryllis family, represented by the genus *Agave*	112	
Stonecrop family	288	
Miscellaneous	4	1,311
Temperate collections, other than ferns and orchids		1,633
Miscellaneous tropical collections, other than those specified above		1,565
		5,808

The succulent collection, as will be seen from the above, is quite extensive, numbering 1,311 species and varieties, and

is the richest in representation. The arid region of southern Africa is well represented by the lily family in many species of *Aloe*, *Gasteria*, *Haworthia* and *Apicra*, and by the milkweed family in the genera *Stapelia* and *Huernia;* while the great arid regions of this continent have a large representation in the cactus family, in numerous genera, and the amaryllis family in the genus *Agave*. The stonecrop family is likewise very rich in rare and interesting forms.

To the naming and labeling of this collection of the cactus family especial attention has been given during the past summer and fall. By far the greater part has been identified and properly labeled, and all have been grouped in genera. On the lower portion of the central bench in no. 5 a sequence of the genera and their species has been arranged, thus much increasing the value of this collection for comparative study. The genus *Opuntia* in house no. 6, on the side benches, has been grouped, the cylindropuntias being confined to one bench, and the platyopuntias, or flat-stemmed ones, to the other; the relationship of species in these two groups has also been indicated by placing in juxtaposition those closely related.

Much work has also been done on the orchids, in identifying and correctly labeling such as have flowered; upon the aroids and bromeliads, the latter of which are also arranged to show the generic sequence, and upon many other families in scattering specimens, as flowers have appeared making this possible.

Labeling, Accessioning and Herbarium.

An average of two apprentices have been employed in this department, with the addition at times of another assistant. Zinc show-labels to the number of 1,961 have been manufactured, and about 6,000 zinc data-labels. For the conservatories 1,578 show-labels have been lettered, for trees 290, and for the herbaceous grounds 294, making a total of 2,162.

Accession numbers 10,651 to 16,867, inclusive, have been registered during the year, making a total of 6,217 accessions.

The total number of plants obtained from all sources has been about 13,000 specimens, of which about 4,000 were derived from the germination of seed. The work of replacing all wooden pot-labels with permanent ones of zinc has been going on and is being continued; at the same time accession numbers are being given to plants received prior to the adoption of numbered accessions.

The herbarium of cultivated plants has been increased by 592 specimens, and all of these, together with many others collected in previous years, have been mounted and incorporated in this herbarium. Part of the time of one assistant was employed during the summer in collecting specimens of the cultivated plants, especially those of the outside collections, and in identifying many of these.

The following table gives the approximate number of spécies in each collection, including those at present in the propagating houses and the nurseries, and the total nnmber, both wild and cultivated, growing within the grounds:

Conservatory	5,808
Herbaceous grounds	3,012
Fruticetum	572
Arboretum	220
Pinetum	81
Salicetum	43
Viticetum	65
Wild flora	860
	10,661

Respectfully submitted,

GEO. V. NASH,
Head Gardener.

REPORT OF THE SUPERINTENDENT OF BUILDINGS AND GROUNDS.

To the Director-in-Chief.

Sir: I have the honor to submit herewith the report of this department, for the year ending December 31, 1902.

Buildings.

1. *Museum.* Only ordinary repairs, such as mending leaks in the roof, painting the window frames and columns at the main entrance, and calcimining part of the walls, were required. About one half of the stone, brick and terra cotta work on the exterior was painted early in the spring. A completion of that work would be desirable for its satisfactory preservation.

The sub-cellar under the lecture hall has been flooded twice by heavy rain-storms owing to unexpected clogging of the drains from some cause not determined; the trouble was overcome by a temporary new drain connection, but the laying of a new 6- or 8-inch permanent earthen pipe, to outflow behind the building into the lakes, seems to be the only satisfactory way to ensure safety.

2. *Public Conservatories.* These houses have been kept well painted on the interior wherever it could be done without removing plants.

Very little breakage of glass has been caused by snow-storms or by expansion or contraction; about 83 lights however were broken, and other damages done to the framework, by unprotected blasts of rock near the eastern wing of the buildings by the John B. Devlin Contracting Company, for which I submitted to you an itemized bill against this company. The damage was promptly repaired.

Five air-shafts of brick and cement have been built on the subways, for ventilation.

3. *Propagating Houses.* These houses have required only minor repairs. They have been painted wherever it was

necessary, and the roof of the potting house and the cornices around the building, to eighteen inches below the roof, have been puttied and painted with metallic paint. It appears, however, that the dampness still settles in the brick walls, as may be seen after every heavy rain-storm. The insertion of ventilating pipes between the roof and the ceiling may overcome this.

4. *Barn.* Only minor repairs have been necessary during the year; the framework has been painted, and the stalls put in good condition. Since the purchase of another horse last March all the stalls have been occupied, and an extension of the shed, for the storage of wagons and carts, will be very desirable. A new single spring-wagon is wanted for the use of the gardeners at the opening of the season. We have been feeding hay of the crop of 1901 up to date and the hay barracks of 1902 contain about sixteen tons of good quality.

The cost of repairs for harness, carts and other equipments, amounts to $176.29, including one new cart and one new harness; of horse-shoeing, $111.75; of oats, bran, salt and straw, $668.78, due to the high price of oats during the season.

The agricultural machinery and other equipments are in fair condition, but some trivial repairs will be required. The sanitary condition of the stable is good, and none of the horses has been sick during the year.

5. *Power House.* The interior of the motor-room and all the doors and woodwork of the building have been thoroughly repaired and painted. The flooding of the floor of the building has been overcome by grading and draining the surrounding ground. The bursting of the steam-pipe between the power house and the museum, made it necessary to open the subway southwest of the museum, about 100 feet in length, in order to make the necessary repairs.

Construction of Roads and Paths.

The driveway (25 feet in width) entering northwest of the herbaceous grounds, and extending through the woods to

Pelham Avenue, of which the Telford foundation was laid in 1901 about half-way, has been completed to the southern line of the garden reservation, a distance of about 1,600 feet. Only minor work, such as draining and grading the edges, will be required to finish this work in the spring. In connection with the paths constructed by the John B. Devlin Contracting Co., we have built and completed 1,500 feet of paths on the terrace of the conservatories; and a path 310 feet in length to connect them with those leading to the herbaceous grounds.

There have been completed abôut one half of the paths of which the Telford foundation was laid in 1901, along the west side of the herbaceous grounds (all 11 feet in width), and two thirds of the path from the eastern drinking fountain toward the herbaceous grounds (about 280 feet). A road has been constructed to connect the main driveway with the cellar of the conservatories.

The entrance to the Garden from the Southern Boulevard bridge has been graded and regulated, and two paths completed, one leading northerly and ending at the Harlem Railroad station, and one curving to the southwest ending at the coal-delivery road of the power house; this, when continued, will lead to the Manhattan Railway station. A path on the east side of the main driveway has been connected with one built by the Devlin Company, and taking a northerly direction ends at the drinking fountain in front of the museum; it is now open from the Manhattan Railway station approach to the museum building. Work on the road, 40 feet in width, under construction from the lake through the fruticetum and north meadows to the northern boundary of the Garden and across the river, is progressing. Over 500 cubic yards of top-soil have been removed in grading for this road and hauled in front of the museum building.

Drainage and Sewerage.

The sewer in progress of construction at the time of my last annual report, on the Southern Boulevard, from Webster

Avenue to the New York Central & Hudson River Railroad, built of 24-inch double-strength pipe, has been successfully completed to that point, and connected with the 36-inch brick sewer formerly built by the railroad company under the bridge. To continue this work an excavation of about twenty-six feet in depth will be necessary, at the easterly side of the railroad, for a distance of fifty feet; and of about seven feet in depth for 350 feet to connect with the drainage-system constructed by the Devlin Co.

Seven catch-basins have been constructed, and connected with the main drains, six of them of brick and portland cement, and one of double-strength sewer-pipe, 24 inches in diameter and six feet in depth, all with cast-iron covers.

There was laid 390 feet of 6-inch earthenware pipe, to connect three basins, near the path in front of the conservatories, with the main drain; and 120 feet to connect a basin near the Manhattan Railway approach; in all we have laid about 640 feet of 6-inch pipe to connect the newly constructed basins.

A drainage-system has been completed in the north meadows, west of the Bronx River, and about 7,000 feet of 1-, 2-, 3-, 4-, 5-, 6- and 8-inch porous pipe and sewer-pipe has been laid, and connected with a brick basin near the river shore, emptying into the river. At the lowest point a culvert about 116 feet in length has been constructed, of 24-inch double-strength sewer-pipe, laid on a concrete of portland cement and broken stone, under the road and paths in course of construction, and connected by an open trench with the river.

Grading and Sodding.

The grading and sodding south and east of the museum building is nearly completed, also the grading of the grounds west and southwest of the conservatories. Much of the sod and topsoil used for that purpose had to be hauled from the new road and path-lines of the fruticetum. We have sowed about 6,500 square yards of surface in various parts of the grounds. A pond for water-plants at the herbaceous grounds, in course of construction at my last annual report, was completed early in the spring.

Water-pipes.

There have been laid five sections of one-inch galvanized pipe each 60 feet in length, 150 feet apart, crossing under the new road on the fruticetum, to be connected when the main is laid through that area.

Improvements on Bronx River.

The river has been cleared from obstructions, such as stones, fallen trees, stumps and branches, from the northern boundary to the blue bridge. A temporary service bridge has been built, about halfway between the blue bridge and the northern boundary.

The dam opposite the Lorillard Mansion has been reconstructed; this makes the dam fourteen inches lower than the old wooden structure, reducing the normal height of the water at the blue bridge about one foot.

The increase of the working force has made it necessary to purchase a number of new tools and other equipment; an inventory was prepared and submitted, December 12, 1902, by the foreman and gardeners, and all not in use during the winter season have been returned and stored.

Respectfully submitted,

F. A. Schilling,

Superintendent of Buildings and Grounds.

SCHEDULE OF EXPENDITURES DURING 1902, UNDER APPROPRIATIONS MADE BY THE BOARD OF MANAGERS.

1. City Maintenance Account		$65,000.00
Salaries and Labor.		
Appropriated..	51,401.06	
Expended..	51,401.06	
Supplies and Repairs.		
Appropriated	13,598.94	
Expended..	13,598.94	
Total expended..		65,000.00
2. Construction, Improving and Equipment		21,647.04
Salaries and Labor.		
Appropriated..	15,616.33	
Expended..	15,616.33	
Sundry Expenses.		
Appropriated..	6,030.71	
Expended	6,030.71	
Total expended..		21,647.04
3. Garden Accounts, General Fund.		
Museums and Herbarium.		
Appropriated..	2,800.00	
Transferred from Library........................	200.00	
Transferred from Horticultural Prizes......	88.10	
Transferred from Insurance..	85.10	3,173.20
Expended..		3,173.08
Balance..		.12
Library.		
Appropriated..		2,900.00
Expended..	2,699.83	
Transferred to Museums and Herbarium...	200.00	2,899.83
Balance		.17

Laboratories.

Appropriated		1,000.00
Expended		999.35
Balance		.65

Publications.

Appropriated		1,500.00
Expended		1,499.55
Balance		.45

Exploration and Collecting.

Appropriated		2,500.00
Expended		2,497.27
Balance		2.73

Lectures.

Appropriated		400.00
Expended		399.38
Balance		.62

Horticultural Prizes.

Appropriated		500.00
Expended	411.90	
Transferred to Museums and Herbarium	88.10	500.00

Investigations at other Gardens and Museums.

Appropriated		1,000.00
Expended		999.38
Balance		.62

Contingent Fund.

Appropriated	1,800.00	
Refund of fee (Bequest of Judge Daly)	75.00	1,875.00
Expended		1,874.33
Balance		.67

Stable Equipment.

Appropriated	200.00	
Transferred from Circulars for Membership.	50.00	
Transferred from Circulars for Membership.	20.63	270.63
Expended		269.33
Balance		1.30

Purchase of Plants.

Appropriated		400.00
Expended		399.48
Balance		.52

Circulars for Membership.

Appropriated		400.00
Expended	329.37	
Transferred to Stable Equipment	50.00	
Transferred to Stable Equipment	20.63	400.00

Landscape Engineering.

Appropriated		720.00
Expended		720.00

Insurance on Collections.

Appropriated	400.00	
Refund (on Insurance overpaid)	151.30	551.30
Expended	466.20	
Transferred to Museums and Herbarium	85.10	551.30

Special Assistance.

Appropriated		300.00
Expended		300.00

Grading, Drainage and Water Supply.

Appropriated		3,278.00
Expended		3,273.25
Balance		4.75

Special appropriation of Board of Managers made May 15, 1902, (Pictures).

Appropriated		500.00
Expended		500.00

Income of Lydig Fund.

Appropriated		600.00
Expended		584.38
Balance		15.62

Income of Stokes Fund.

Appropriated		120.00
Expended		119.82
Balance		.18

Income of Students' Research Fund.

Appropriated		50.00
Balance		50.00

Total Appropriated for Garden Accounts	21,368.00	
Refunds	226.30	21,594.30
Total Expended for Garden Accounts		21,515.90
Balance		78.40

4. Special Garden Accounts.

Conservatory Fund.

Subscribed, 1900	2,110.00	
Subscribed, 1901	25.00	
Refund — Balance on Draft	15.27	
Subscribed, 1902	486.55	
Refund — Unexpended Balance	9.70	2,646.52
Expended, 1900	710.44	
Expended, 1901	1,437.42	
Expended, 1902	404.41	2,552.27
Balance		94.25

Special Book Fund.

Subscribed, 1899	4,950.00	
Subscribed, 1901	1,825.00	
Subscribed, 1902	2,265.00	9,040.00
Expended, 1899	1,916.65	
Expended, 1900	2,395.28	
Expended, 1901	2,463.02	
Expended, 1902	2,256.25	9,031.20
Balance		8.80

Exploration Fund.

Subscribed, 1901	2,050.00	
Refunds — Balance on Drafts	87.59	
Subscribed, 1902	2,130.00	
Refund — Unexpended Balance	180.56	4,448.15
Expended, 1901	2,130.95	
Expended, 1902	1,258.32	3,389.27
Balance		1,058.88

Museum and Herbarium Fund.

Subscribed, 1901	1,800.00	
Subscribed, 1902	655.00	
Refund (Advance Charges on Specimens, account of R. S. Williams)	131.09	2,586.09
Expended, 1901	1,546.19	
Expended, 1902	1,024.96	2,571.15
Balance		14.94
Total Expenditures from Funds of the Garden		26,459.84

WALTER S. GROESBECK,
Accountant.

NEW YORK, January 12, 1903.

REPORT OF THE SCIENTIFIC DIRECTORS.

To the Board of Managers, New York Botanical Garden.

Gentlemen: The Board of Scientific Directors has held two meetings during the current year, on May 6 and on November 18. At the first meeting the appointment of Dr. W. J. Gies as consulting chemist was made, subject to your approval, and a new plan was definitely outlined for the establishment of scholarships to aid botanical research. At the later meeting these scholarships were recommended subject to your approval, and tentative rules for their operation were approved.

The scientific work in progress at the Garden has been found to be in a most healthful condition, as shown by the productive work of members of the staff, by the extensive explorations carried on by officers of the Garden, by the training of research students along various lines of botanical work, and by the educational influence of the public collections in museum and conservatories.

The appointment of Dr. Gies, in connection with the fitting up of the chemical laboratories at the museum, is a distinct advance in the direction of research along one of the most important lines of applied botany.

The report of the Director of the laboratories indicates no less than forty research students in attendance during the year 1902, representing graduates of no less than twenty-three institutions of collegiate rank. The provision for two research scholarships for advanced workers, is a most notable step in the widening of the influence of the Garden, and will be a decided advantage to the advancement of botanical science in making possible the completion of research work by skilled botanists whose field of labor is now somewhat isolated, and at the same time will prove a distinct and material advantage to the interests of the Garden itself.

Exploration, publication and the instruction of trained men and women for botanical research are thus being carried on hand in hand, and the results already attained justify the hearty coöperation hitherto received from the Board of Managers. The outlook for scientific work at the Garden promises a still more brilliant future.

Very respectfully yours,

LUCIEN M. UNDERWOOD,

Chairman.

JANUARY 12, 1903.

REPORT OF THE COMMITTEE ON PATRONS, FELLOWS AND MEMBERS.

To the Board of Managers of the New York Botanical Garden.

Gentlemen: The number of new members who have qualified during the past year is 143. The total number of annual members is now 907.

Of these 22 are in arrears for dues for 1902, 11 are in arrears for dues for 1901 and 1902, and one is in arrears for 1900, 1901 and 1902.

Annual dues have been collected to the amount of $9,040.00, which has been transmitted to the Treasurer as received.

Forty-seven persons have qualified as life members by the payment of $100 each. One person has qualified as a Patron by the payment of $5,000.00. These sums have been transmitted to the Treasurer for credit to the Endowment Fund.

A complete list of Patrons, Fellows for Life, Life Members and Annual Members to date is herewith submitted.

New York, January 12, 1903.

Patrons.

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Mrs. Geo. Whitfield Collard,
Columbia University,
*James M. Constable,
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*Wm. C. Schermerhorn,
Jas. A. Scrymser,
Samuel Sloan,
*Cornelius Vanderbilt,
Mrs. Antoinette Eno Wood.

*Deceased.

Fellows for Life.

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David B. Ivison,
Morris K. Jesup,
John Innes Kane,
Hon. Seth Low,
Miss Caroline Phelps Stokes,
Miss Olivia E. Phelps Stokes,
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Tiffany & Co.,
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Wm. A. Anthony,
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Samuel P. Avery, Jr.,
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Dr. John Hendley Barnhart,
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Theodore Cooper,
Zenas Crane,
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John Stanton,
Jno. N. Stearns,
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James R. Steers,
H. Steinmann,
Chas. H. Steinway,
Benjamin Stern,
Isaac Stern,
Louis Stern,
Winfield S. Stern,
Olin J. Stephens,
Alexander H. Stevens,
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Frederic W. Stevens,
Lispenard Stewart,
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Jos. Stickney,
Miss Clara F. Stillman,
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James Stokes,
Mason A. Stone,
Sumner R. Stone,
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C. A. Tatum,
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H. L. Terrell,
Jno. T. Terry,
Nikola Tesla,
Thomas Thacher,
Ernst Thalmann,
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Seth E. Thomas,
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L. S. Thompson,
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W. V. S. Thorne,
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C. C. Tiffany,
Estate of C. L. Tiffany,
Louis C. Tiffany,
James Timpson,
E. Titus, Jr.,
J. Kennedy Todd,
William Toel,
William Toothe,
William Tousey,
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R. W. Townsend,
C. D. Tows,
J. Evarts Tracy,
Edwin D. Trowbridge,
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Edward A. Wickes,
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Robt. F. Wilkinson,

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Robt. R. Willets,
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Edw. L. Young,
Andrew C. Zabriskie,
Wm. Ziegler,
August Zinsser,
O. F. Zollikoffer.

REPORT OF THE TREASURER.

New York, January 12, 1903.

To the Board of Managers of
the New York Botanical Garden.

Gentlemen: Herewith I submit a statement of my receipts and disbursements during the year 1902, and a balance sheet from my ledger as of December 31, 1902.

Respectfully yours,

C. F. Cox, *Treasurer.*

Receipts.

Balance as per last Annual Report......		$ 3,525.48
Contributions of the City towards Development and Maintenance.............		83,803.88
Income from Investments:		
5 per cent. on $50,000 Southern Ry. Co. First Consol. Mtge. Bonds...	$ 2,500.00	
4½ per cent. on $50,000 Ches. & Ohio R. R. Genl. Mtge. Bonds...	2,250.00	
4 per cent. on $50,000 Erie R. R. Prior Lien Bonds	2,000.00	
4 per cent. on $59,000 Erie R. R. Penn. Collat. Trust Bonds.........	2,360.00	
4 per cent. on $50,000 Reading R. R. Jersey Central Collat. Trust Bonds..................................	2,000.00	
4 per cent. on $24,000 Nor. Pac., St. Paul & Duluth Divn. Bonds...	960.00	
4 per cent. on $14,000 Nor. Pac., Gt. Northern, C. B. & Q. Collat. Trust Bonds..........................	560.00	12,630.00
Annual Dues..................................		9,060.00
Interest at 3 per cent. on balances on deposit with J. P. Morgan & Co.........		309.77
Proceeds sales of Merchandise, etc.........		438.46
do do Publications		102.09
Life Membership Fees......................		4,600.00

Tuition Fees, credited to Students' Research Fund................		513.00
On a/c of Bequest of Charles P. Daly, credited "David Lydig Fund".........		8,438.91
Contributions to Endowment Fund........		6,025.00
do to Exploration Fund........		2,130.00
do to Special Book Fund......		2,265.00
do to Mus. & Herb. Fund......		905.00
do to Conservatory Fund......		288.00
Payment by Manhattan Ry. Co. of Cost of Viaduct at Entrance of Garden......		15,426.72
		150,461.31

Disbursements.

Additions to Director-in-Chief's "Working Fund" ....$		10,000,00	
Expenses paid through Director-in-Chief a/c City Apppropriation,	$83,803.88		
On General Account, for Vouchers Paid...........	21,657.31	105,461.19	
Prizes for Essays on "Preservation of Native Plants," out of Income of Stokes Fund		100.00	
Reprints of Prize Essays, Account Income of Stokes Fund..............................		19.82	
Books — account Special Book Fund....		1,235.77	
Plants — account Conservatory Fund......		103.40	
Specimens — account Exploration Fund..		531.71	
Specimens — account Museum and Herbarium Fund		1,840.62	
Cost of Viaduct from Manhattan Railway into the Garden		15,426.72	134,719.23
Balance — Cash in hands of Treasurer..			$15,742.08

LEDGER BALANCES, DECEMBER 31, 1902.

Credit.

Permanent Funds:

Endowment Fund........................	$270,775.00
Fellowship Fees	8,000.00
Life Membership Fees..................	14,700.00

Students' Research Fund..............		1,565.75
David Lydig Fund, Bequest of Chas. P. Daly................................		28,904.09
Stokes Fund.....................		3,000.00
Temporary Funds:		
Special Book Fund, for Library......		2,208.31
Conservatory Fund, for Plants........		222.73
Exploration Fund.......................		1,810.58
Museum and Herbarium Fund, for Specimens		464.38
Income, Students' Research Fund...		110.31
do Stokes Fund..................		38.18
do David Lydig Fund		1,567.97

Debit.

Investments:		
Net Cost of $50,000 Ches. & Ohio Ry. Co. Genl. Mortgage Bonds.. $50,000 Southern Ry. Co. 1st Consol. Mtge. Bonds.............. $50,000 Erie R. R. Co. Prior Lien Bonds .... $59,000 Erie R. R.-Penn. Collat. Trust Bonds .... $50,000 Reading R. R. Co.-Jersey Cent. Collat. Trust Bonds......... $24,000 Nor. Pacific R. R. Co. St. Paul & Duluth Div. Bonds......... $14,000 Nor. Pacific-Gt. Northern C. B. & Q. Coll. Tr. Bonds......	$287,660.01	
Director-in-Chief, Working Fund	20,000.00	
Construction Account, Cost of plans not yet used.	2,350.00	
General Income Account, Balance borrowed from Permanent Funds...........	7,615.21	
Cash in Hands of Treasurer...	15,742.08	
	$333,367.30	$333,367.30

FEBRUARY 19, 1903.

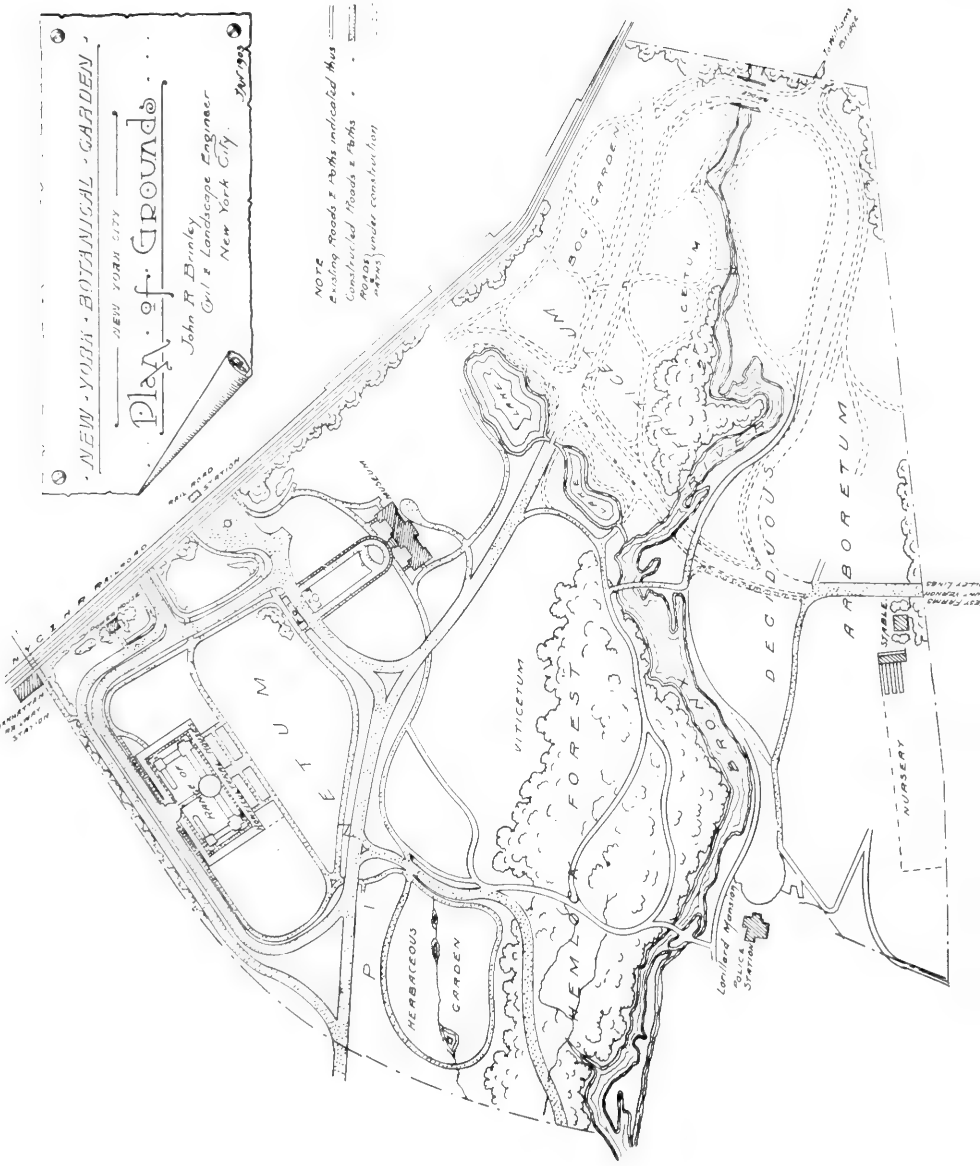
DR. N. L. BRITTON, *Director-in-Chief*,
New York Botanical Garden,
Bronx Park, New York City.

Dear Sir : In response to the request of the Treasurer of the Botanical Garden, Mr. Cox, I have caused his accounts for the year 1902 to be examined and audited and take pleasure in reporting that the same have been found to be correct, in accordance with the Balance Sheet and Statement of Receipts and Disbursements, returned herewith with the Auditor's certificate.

Yours very truly,
JAMES A. SCRYMSER,
Chairman, *Finance Committee*.

INDEX.

[Names of genera in *italic*.]



PROGRESS MAP,
JANUARY, 1903.

PUBLICATIONS

OF

The New York Botanical Garden

Journal of the New York Botanical Garden, monthly, illustrated, containing notes, news and non-technical articles of general interest. Free to all members of the Garden. To others, 10 cents a copy; $1.00 a year. [Not offered in exchange.] Vol. I, 1900, viii + 213 pp. Vol. II, 1901, viii + 204 pp. Vol. III, 1902, viii + 244 pp.

Bulletin of the New York Botanical Garden, containing the annual reports of the Director-in-Chief and other official documents, and technical articles embodying the results of investigations carried out in the Garden. Free to all members of the Garden; to others, $3.00 per volume. Vol. I, Nos. 1–5, 449 pp., 3 maps, and 12 plates, 1896–1900. Vol. II, Nos. 6 and 7, 480 pp., 28 plates, 1901, 1902; No. 8 is in press.

Memoirs of the New York Botanical Garden. Price to members of the Garden, $1.00 per volume. To others, $2.00. [Not offered in exchange.]

Vol. I. An Annotated Catalogue of the Flora of Montana and the Yellowstone Park, by Dr. Per Axel Rydberg, assistant curator of the museums. An arrangement and critical discussion of the Pteridophytes and Phanerogams of the region with notes from the author's field book and including descriptions of 163 new species. ix + 492 pp. Roy. 8vo, with detailed map.

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Contributions from the New York Botanical Garden. A series of technical papers written by students or members of the staff, and reprinted from journals other than above. Price, 25 cents each.

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BRONX PARK, NEW YORK CITY

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